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## WINE PRESSES AT THE PARIS EXHIBITION.*

At the Paris Exhibition some new and peculiar wine presses are exhibited, which we will describe in the following:

Everybody recollects the old fashioned, clumsy wooden structures which, up to a short time ago, constituted the only means for pressing grapes, etc. Causing a disagreeable, creaking noise when turned, and requiring a large amount of labor on account of the friction of the wooden parts, they took up much room, and were found only few and far between. Wine growers often had to transport their grapes to a press for a great distance, and had then to await their turn; the production of a uniform quality of wine at a moderate cost was hence out of the question.

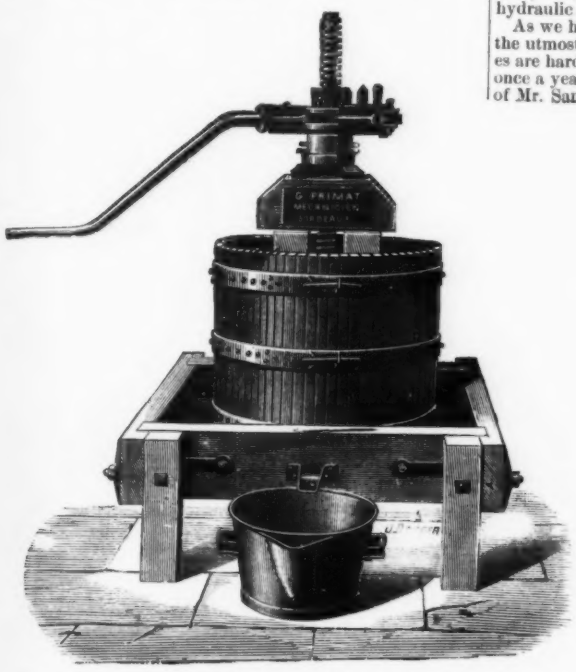
The first improvement in presses consisted in the substitution of metal for wood; the second, in making the press portable, instead of incasing it in stone foundations, as heretofore.

Substitution of metal for wood reduced the friction and the bulk of the press; portability allowed the pressing to be done at each wine grower's premises, so as to save time and money.

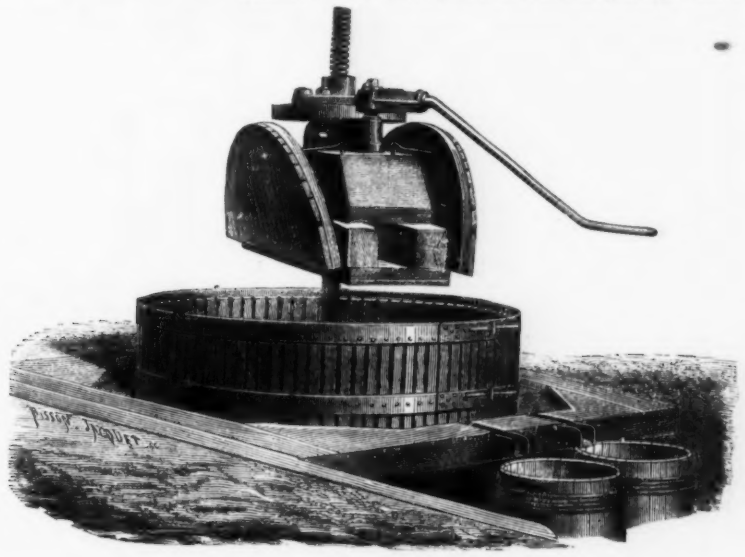
* Condensed from the *Revue Industrielle*.

Next came the invention of hydraulic presses, their comparatively great power being long considered a difficult problem to solve. Many other improvements were made; three presses especially possessing such excellent features, that we may consider them the foundations of nearly all kinds of presses in use at the present day. These were the rhombic press, invented by Revillon in 1824; the hydraulic press, built by Cordier in 1827; and the rochet presses, built by Sadds, Barker, and Adkins, and by Bernard, in 1833 and 1842 respectively. At the International Exhibition at Paris, in 1867, three styles of presses principally laid claim to public favor: the rhombic press of Samain, the presses of Mabille, worked by a system of wheels and levers, and several hydraulic presses exhibited by different makers.

As we have, in agricultural machines, always believed in the utmost simplicity of mechanism, and as hydraulic presses are hardly adapted to work necessary to be performed but once a year, we gave, in 1867, the preference to the system of Mr. Samain.



PRESS PRIMAT.



PRESS MABILLE.

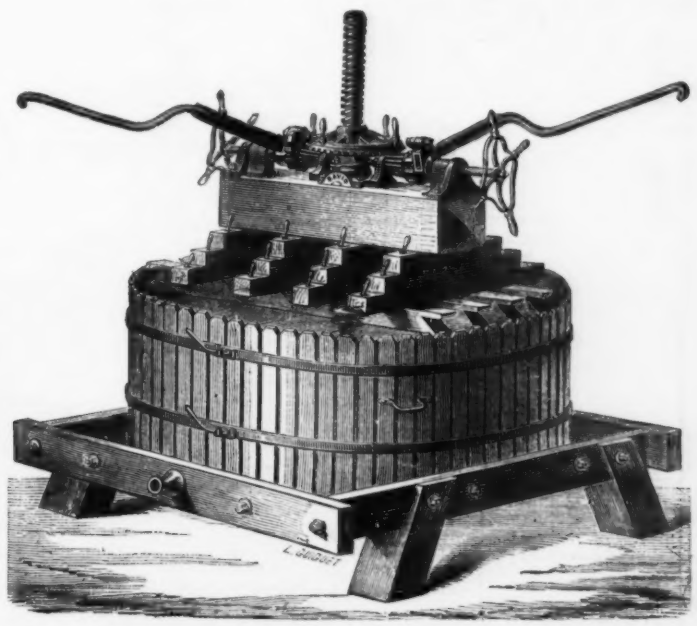
Subsequently, however, at the provincial fair at Dijon, the Mabille Bros., of Amboise, exhibited a press which nearly revolutionized that branch of industry. Its mechanism not offering anything new in any single part, the peculiar arrangement of the same virtually constituted a new invention. Since its first appearance this press has rapidly gained in public favor, over 20,000 having been sold in less than eight years.

Naturally, the Mabille press had to contend with many rivals in a short time, and with pleasure we refer to many excellent machines exhibited this year, such as those of the MM. Samain, Marchand, Primat, David, Noguès, Mailhé, Maupu, and others. As regards simplicity, however, the Mabille press has never been reached. The idea of Mabille of employing a compound lever is not new, it is said; but is this not said of every successful improvement? The fact is, that previous to 1870 nothing similar was in existence. The idea of introducing double action of a compound lever on the female screw of a press was something undeniably new. Outside of the lever, the male screw, the frog, and the traveling nut or female screw, features common to all presses nearly, the Mabille press only consists of two connecting bars, carrying at their ends projections or pins shaped like a rectangular triangle, one larger pivot, and two smaller ones for securing the connecting rods. Should any one know an apparatus of such simplicity, that has been in use previous to 1870, we should be glad to have it brought to our notice.

The press, called by the Mabille Bros. *pressoir universel*, consists, as will be seen in the accompanying drawing, of a female screw or nut, A, in form of a disk, provided with a row of holes near its periphery, and resting directly on a frog, G. Into the holes of the disk are fitted the pins, FF', attached to the connecting rods, EE'. The disk, A, and the frog, G, travel on a fixed central screw, H. Below the frog wooden sleepers may be used as in other presses.

The length of the bars EE', and the position of the pivots, CC', are calculated so that when the lever, B, is moved in either way, one of the pins acts on the disk, A, turning it downward, while the other withdraws from the opening in which it rested. The lever being brought back into its original position, the pin previously passive becomes active, and in its turn moves the disk further downward on its cir-

PRESS MABILLE.

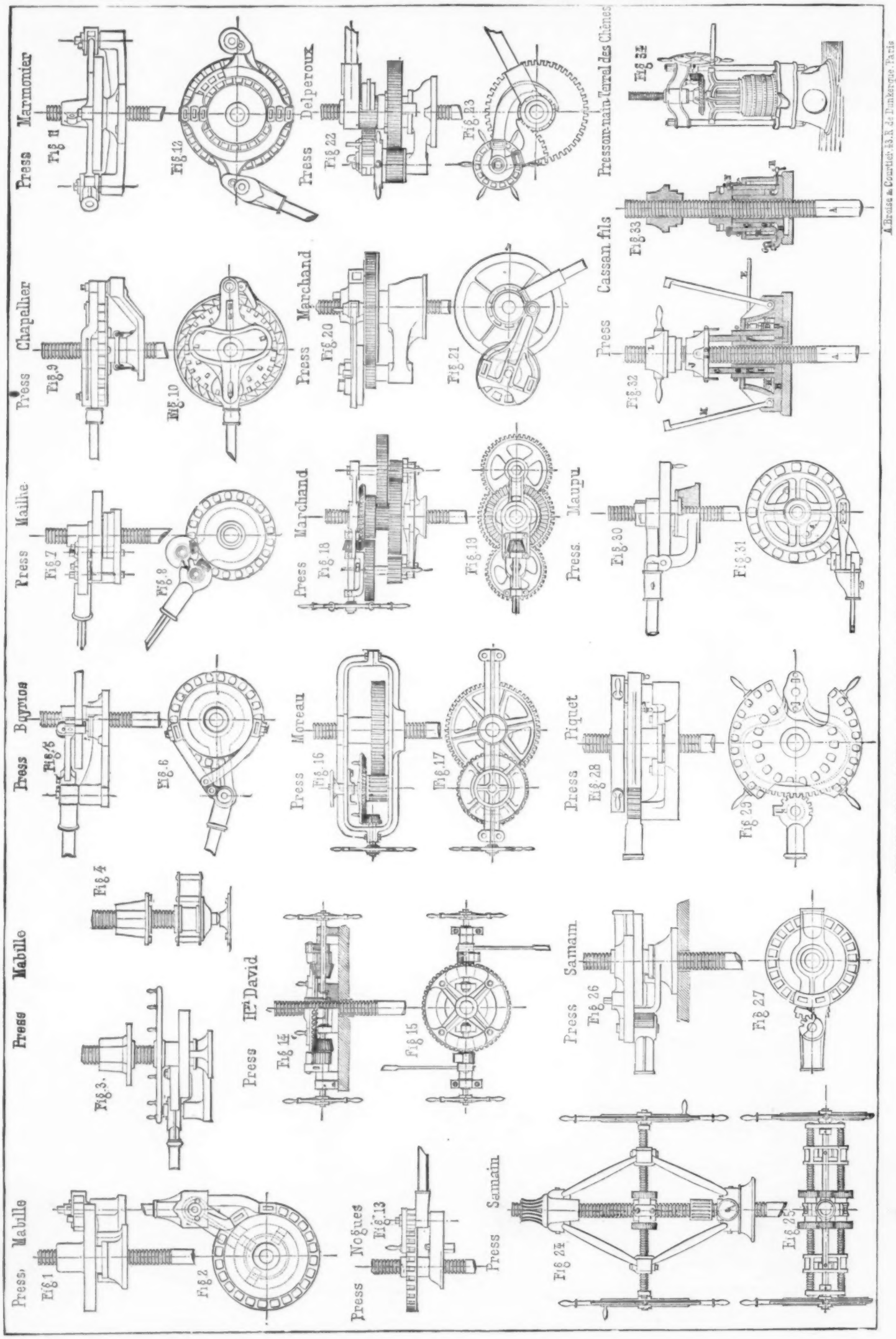


PRESS DAVID.

cular tour. Thus each movement of the lever corresponds to one of the disk and frog.

The lever may be worked rapidly at first, only little pressure being required, till the resistance increases gradually, and the lever is consequently moved slower. Instead of complicating the press by devices calculated to insure a uniform speed of operation, the inventors have preferred to leave the regulation of force and speed to the operator, a task which to perform the human frame is peculiarly adapted. In order to raise the mechanism, the connecting rods are changed in position and the lever moved as before. The frog is attached to the disk, A, by clamps.

In order to give an idea of the power of these presses, the following elementary calculation will be sufficient; we leave aside the friction caused by the accessory parts:



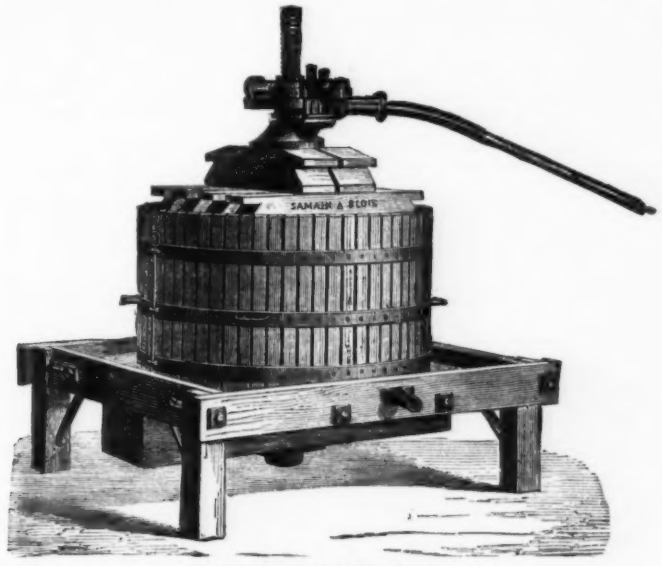

WINE PRESSES AT THE PARIS EXHIBITION.

Calling P the force applied to the end of the lever, B, Q the resistance offered by the compressed material, L the total length of the lever, $l$ the small end of the lever, R the radius of the disk, A, to the center of the holes, $r$ the mean radius of the screw, $h$ the screw thread, $f$ the coefficient of friction, we will have

$$Q = \frac{R}{r} \times \frac{L}{l} \times \frac{2\pi r f h}{h + 2\pi r f} \times P$$

Taking the length of the lever as 2 m., that of the smaller arm as 0·05 m., the radius of the disk as 0·26 m., the diameter of the screw as 0·09 m., a screw thread of 0·022 m., and the coefficient of friction as 0·10 m., we arrive, according to above formula at Q=1289 P, as the result.

PRESS MAILHE.



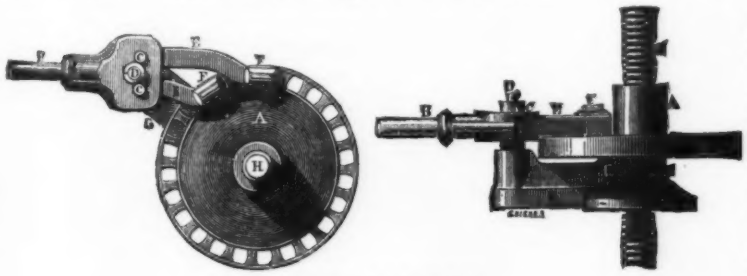

PRESS SAMAIN.

Taking 40 kg. as the average power of one man, two men working simultaneously could exert on the material a pressure of

$$40 \times 2 \times 1{,}289 = 103{,}120 \text{ kg.}$$

This enormous pressure, if actually applied to the press, would rapidly destroy it In order to obviate this the lever, which can always be easily replaced, is constructed in such dimensions that it would, in case of application of too large a force, break before any other parts of the press could be injured.

In the accompanying table, Fig. 3 represents the application of the system Mabille to a movable screw. The female screw is here stationary, and the descending screw acts directly on the wooden sleepers. By a wheel provided with handles the screw may be readily raised after the operation. Fig. 4 shows a device made by the same firm destined to replace the wooden screw in old cheek presses.



PRESS MABILLE

The Mabille presses are made in ten different sizes, ranging from a capacity of two to one of 53 hectoliters, and from five to fifteen centimeters diameter of screw, costing from 150 to 4,870 francs respectively.

*The Samain Presses.*—Samain, the well-known manufacturer of Blois, the inventor of rotary pumps, of hydraulic apparatus, and of important improvements in firearms, exhibits two styles of presses: one is a rhombic press (Figs. 24 and 25), the other is operated by a system of levers.

As the former class of presses has often been described, we shall merely discuss the second press exhibited. This consists of a lever connected with a center piece turning around the fixed screw. This center piece is provided with two movable pins, acting alternately on a wheel provided with holes near its periphery, and forming virtually one body with the nut. The lever may, in the beginning of the operation, move quite rapidly, as it acts directly on the nut; when the resistance increases, the force is applied to a second toothed lever, sitting eccentrically on a projection of the pressure piece. This second lever is engaged by the first one by means of four teeth. This latter feature of a lever provided with teeth we do not fancy much; otherwise the machine is very simple and powerful, and we can cheerfully recommend it to all wine growers. As the lever only works in one direction, the operator may rest while he brings it back without load. This would only be of disadvantage in large presses worked by two or four men, as when the press works in both directions one or two of the operators may always rest, without interfering with the continual action of the machine. The second lever, to facilitate an increase of power, we believe, is of little advantage.

The Samain presses are less expensive than those of Mabille; their price ranges, for a capacity of from 5 to 80 hectoliters, and a diameter of screw of from 6 to 15 centimeters, from 350 to 1,870 francs.

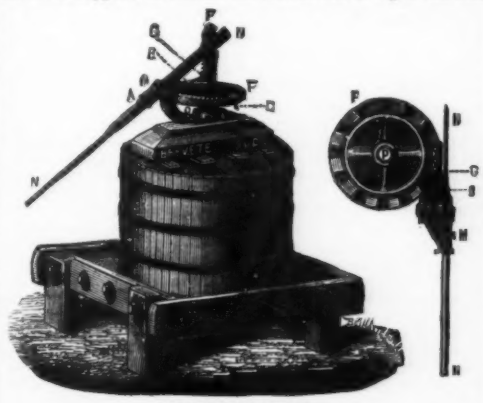
*The David Press* is illustrated in the accompanying cuts, and in Figs. 14 and 15 on the large table. In the mechanism a female screw, in form of a large wheel, travels on a male screw fixed in the center of the press. It is, on its upper case, as, taking friction and durability into consideration, iron seems to be most advisable. Mabille Bros. have sold twenty times as many presses as Mr. David, and they report as coming back for repair only those having female screws of brass. Practical experience is the best guide.

*The Marchand Press.*—Mr. Marchand fils, of Tours, has exhibited two styles of presses, one operated by a complicated system of gearing, the other a little more simple, and operated partly by levers. (Figs. 18, 19, 20, and 21.) The former, having obtained the first prize at Narbonne in 1872, is constructed entirely different from the presses described so far. It consists of three pairs of wheels, permitting a threefold change of pressure in operating, and of two eccentrics.

The second press of Mr. Marchand is calculated for two rates of speed. For the first a lever is used, which, by means of a muff and pin, acts directly on the nut. The second rate of speed is obtained through the same lever, and a movable plate with three pins bolted to the muff. The impulse imparted to the plate is transmitted to the pins, entering in opposite directions into the holes provided for them, thereby producing continuous motion. This machine is more simple than the preceding, but yet a little too complicated.

*The Maupu Press.*—This consists of the joint, A, receiving the movable vertical lever, N, a connecting bar, B, transmitting the motion to a wheel, F, provided with handles, C, and a row of holes, engaging the connecting bar, B, and the pin, G. The latter may be reversed for raising the mechanism. The lever, N, is held in position by the screw, M. The frog, O, traveling on the fixed screw, P, receives the pressure and supports the articulation, A. As is seen from the accompanying drawing, the lever moves in vertical direction.

*The Boyries Press.*—Mr. Boyries, of Soissons, only manufactures presses of the system Mabille, differing from this only in so far as, instead of pivoting both connecting bars to the lever support, he fastens the second one on top of the first



PRESS MAUPU.

one. The result is the same; but as the modification weakens the lower connecting bar to some extent, it might be better to adhere to the original plan. It is useless to alter a good machine for the mere satisfaction of making a change.

*The Chapellier Press.*—This is ingenious enough. It is composed (Figs. 9 and 10) of a lever imparting an oscillating movement to a claw situated at its end. This claw engages a bridge and pins, acting on an exterior ratchet and a series of interior openings. This press possesses a threefold compensation of speed. It only falls short of completeness in one point; it lacks the extreme simplicity of the Mabille press.

*The Marmonier Press.*—Figs. 11 and 12 give an idea of this press, in which Mr. Marmonier fils, of Lyons, has retained the feature of pins engaging in openings in a circular disk, complicated, however, by the introduction of two additional rows of holes, allowing a compensation of speed. The construction seems good, and the various dimensions based on careful study.

*The Cassan Press.*—Mr. Cassan fils, of Jallieu (Isère), exhibits a hydraulic press of quite original construction, but hardly adapted to agricultural purposes. It is composed (Figs. 32 and 33) of a fixed screw, A, a reservoir, B, an annular piston, C, a hand pump, D, an operating lever, E, a return water gate, F, a safety valve, G, a water chamber, H, a cylinder, I, a female screw or nut, J, a second nut, L, two supports, MM, and a double collar, N, for raising the reservoir. The operator proceeds as follows: After ramming down the sleeper as much as possible by pumping, he braces the nut, L, by the supports, MM, then opens the water gate and causes the nut, J, and the annular piston to descend. Pumping is then resumed, and the operation repeated as often as necessary.

*The Noguès Press.*—This apparatus, shown in Fig. 13, is a simple device, consisting of a frog acted upon directly by a pair of toothed wheels. The latter are moved by a lever, and provided with an attachment to increase the pressure when necessary.

*The Mailhé Press.*—Mr. Mailhé, of Orthez (Basses-Pyrénées), exhibits a press working only in one direction, which we represent in the accompanying engraving, and one working during both journeys of the lever, shown in Figs. 7 and 8. Their construction is very simple, but lacks originality.

*The Primat Press.*—Mr. Primat, of Bordeaux, presents two different presses, one with conical cogwheels and a lever moving in vertical direction; the other with a horizontal lever and operating continuously. The latter, represented in the engraving, is composed of two disks, the lower one of which is provided with holes, the upper one with three pins; a lever pivoted to the frog, and a connecting bar, one end of which is engaged by the lever, the other being connected with the upper disk. This press may be ranked next to those of Mabille, Samain, David, and Marchand.

*The Moreau Press.*—In this press a continuous circular motion in horizontal direction is simply converted into a vertical one by means of conical and cylindrical cogwheels. One of the latter, directly engaging the nut, is in the beginning turned by a handle, the gearing only being brought into action when the resistance becomes greater.

*The Piquet Press.*—This press, exhibited by Mr. Piquet, of Sartrouville, is operated by a toothed lever, and is very powerful, having, in 1877, received the first prize at Angoulême, in consequence of some tests made with moistened sawdust. It is represented in Figs. 28 and 29. The only objectionable feature we find is in the toothed lever, otherwise it might be called perfect.

*The Delpéroux Press.*—This is shown in Figs. 22 and 23. It acts continuously and allows a threefold regulation of speed and pressure. A large cogwheel acts on a movable nut, long enough for guiding a pinion situated above the wheel and engaged by the lever. Two arms, situated at the sides of the screw, carry pins sliding over a plate provided with a row of holes, and are eccentrically pivoted on the frog. These two arms are toothed and engage two pinions. The whole is a little complicated, but quite an ingenious construction.

*The Terrel des Chênes Press.*—This peculiar apparatus, represented in Fig 34, and invented by M. Terrel des Chênes, is based upon the principle of "successive application of the greatest possible power on very small quantities of material." The nut is stationary, while the screw is moved by two cogwheels and brought to bear successively on different portions of the material.

There are many other presses exhibited by different manufacturers, but our space does not permit us to describe them all. We will only mention the presses of Lemaire, Auger et Amiot, and of Flamain, with a double, and those of Gaillot, with an endless, screw.

In the whole, the wine presses on exhibition show, compared with 1867, an immense progress as regards ingenuity and durability of construction.

Pecuniarily, the Mabille Bros. have so far been most successful; they sell more presses annually than all the rest of the manufacturers combined.

HIPPOLYTE FONTAINE.

## THE ALGERIAN EXHIBITION, PARIS.

THE Algerian pavilion presents a most complete and interesting appearance. Besides a certain number of articles usually kept in the Palais de l'Industrie in the Champs Elysées, praiseworthy efforts to respond to the invitation of the Minister of Agriculture and Commerce have brought together a variety of objects from the Algerian colonies well meriting inspection. Over two thousand exhibitors, the majority of whom show agricultural or alimentary products, have arranged their goods under the superintendence of M. Brosselard, former prefect of Oran, the commissioner of the general government of Algeria, assisted by M. des Dyannes, Commissioner of the Algerian Exhibition.

The Algerian Palace on the Trocadero, built in a purely Arabian style, affects the arrangements of a huge caravansary. Four towers with Moorish windows rise at each angle. One of these, which is more than thirty meters in height, represents a minaret, the ornaments of which are borrowed from the ruined portico of El-Mansoura. This lofty minaret is seen from a considerable distance if the visitor travels by water to the Exhibition, and its beautiful proportions will be observed in an engraving we publish this week. The interior of the building is composed of four galleries nearly ten meters in length, opening on to a peristyle of Moorish arcades surrounding a garden, in the center of which rises an Oriental fountain, which charmingly completes the style of the building and dispenses a refreshing coolness throughout the palace. In the further portion of the edifice, at the entrance to a sort of saloon, fitted with a circular divan covered with rich stuffs, is placed a marble bust of General Chanzy, the work of the sculptor Croisy. Artistically grouped together are trophies from the provinces of Algeria Oran, and Constantine, potteries, trays, basins, firearms, musical instruments, skins of the fallow deer, etc.

In the section devoted to furs is the celebrated lion of Bona, called the "Solitaire," whose fur is estimated to have the exceptional value of 4,000f. Close by are beautiful specimens of Algerian marble and onyx, and several graceful vases of serpentine marble. Here, too, we find carpets from Algeria (similar in character to the Wilton carpets), which, in the quality of the wool and the arrangements of the tints, as wel as the grace and variety of the designs, remind one of the carpets from the Levant. There are, also, many curious specimens of ceramic art. An interesting circumstance connected with Algerian pottery is the fact that, among the Kabyles, the Etruscan form taught them by the Romans is still preserved.

The manufacture of furniture, which is improving, will probably be greatly developed, on account of the quantity and variety of the woods in which Algeria is rich. Among the fancy goods, the quaint pipes used by the Arabs, consisting of a long tube, of the wood of the cherry tree, usually inlaid with copper, mother-of-pearl, or coral, will repay examination. Finally, the large maps, the extraordinary collection of musical instruments, such as the *kouitra*, a kind of mandolin, the *kemendja*, a violin with four strings, etc., photographs and immense panoramas of charming landscapes, curious monuments, with picturesque views of the Tell and the Sahara, as well as indigenous types and costumes, combine to represent to us Algeria graphically and at its best.

In the garden which surrounds the Algerian Palace (the Algerian Park) are several tiny pavilions, kept by Algerian venders of oriental stuffs, jewelry, and fancy articles. One little wooden shop does a flourishing trade in every species of North African fruit. Toward the end of the walk leading to the Bridge of Jena is a specimen of the houses constructed in Algeria by the Protection Society, founded in 1871 for the relief of the families of Alsace-Lorraine, and presided over by the Count d'Haussonville. The first floor of this pavilion gives an exact idea of the dwelling of a colonist. On the ground floor is a large room filled with small models in reliefs, several maps of the territories conceded, as well as plans of the villages founded by the colonists, particularly those bearing the name of *Haussonville*. Upon a table is a collection of all the fruits of Algeria—dates, citrons, figs, lemons, pistachios, guavas, jujubes, etc. Here are also the portraits of MM. Nurois and Fardoux, the benevolent founders of the Orphan Asylum at Vesinet, which was inaugurated toward the end of 1876 for the reception of fifty children from Alsace and Lorraine.

Among the kindly acts of the Protection Society, the colonists, upon their arrival in Algeria, were provided with suitable furniture, stores sufficient to last them until harvest-time, with agricultural implements, and grain for sowing the soil; and it is satisfactory to find that many of these colonists are now able to maintain themselves, and will become owners of their land when they have repaid the advances made to them in the time of their need.—*Illustrated Paris Univer. Exhib.*

## WOOLEN FABRICS AT THE PARIS EXHIBITION.

AFTER going the round of the Exhibition it is difficult to resist the conclusion that design, as applied to fancy woolen trowserings, has been all but stationary during the last few years. It cannot be that our foreign rivals have shot ahead of us in this particular, as there are too many traces all over the Exhibition that their cues, or ideas, have had an English origin. It may be that our chief designers in Britain, as well as those on the Continent, have given the lion's share of their attention to the more fashionable worsted fabrics, but perhaps one of the most remarkable is the exhibit of worsted coatings from Roubaix and the neighboring town of Tourcoing, which produced some most beautiful worsted coatings from "singles," and which are rapidly supplanting English makes from "two-folds" in many of the American and other markets. There is a remarkable softness, suppleness, brightness of color, and luster in these goods, arising in part, no doubt, from their different mode of spinning. There are many points about these cloths to which English manufacturers would do well to give heed.

Next after the French in fullness of display and in point of merit come the Austrian Brünn manufacturers of woolens, who, without commanding any special commendation for their designs, have a fine display of good serviceable cloths, calculated to supply a wide market in Central Europe, and to interfere very materially with our exports to the Continent. The cloths of Friedrich Redleigh deserve special mention. His cords are cheap and good, and some of the fancy trowserings are exceedingly neat and well made, and choicely colored; and though we may take a little exception to the stiffness of some of the patterns in point of design, and though they are not finished and got up in a style equal to ours, still they are firm and substantially made, and will satisfy the great bulk of wearers. They are cloths by no means to be despised, and the wear of which will not disgrace a gentleman.

Trenkler & Söhnn, of Reichenberg, also stand well in their exhibit, and we think that there cannot be two opinions as to the progress these Continental people are making, and that they are following hard after us and getting nearer and nearer to us, and that, henceforth, we must not loiter, but *run* in the race if we mean to win.

The exhibit from the Duchy of Luxembourg is very good, and deserves a patient and careful inspection on account of

THE PARIS EXHIBITION—THE STREET OF ALGIERS.

are shown is a sight worth going a long way o'er flood and field to see; the variety and novelty, the boldness—even to wildness—of some of their designs, the facility with which they press into their service all kinds of materials for yarns—even to hair and feathers—make up an assemblage of fabrics truly marvelous. Even their plainer kinds of cloth in self colors, such as cords, are round, smart, and perfect in the rib and clear in the fore to a degree that we have never seen excelled. The same remarks as to distinctness and clearness of outline, regularity, and evenness of surface, apply to their dark trowserings in worsted and imitation worsted, which are a model of good manufacturing. Then turning to the soft overcoatings and mantling cloths, they are something superb and unique in softness and deliciousness of handle, though some of the styles may be considered extreme, tested by English taste. The incorporation of peacocks' feathers, for instance, even in a mantling cloth, would be considered a little "ultra" north of the channel, though not thought to be so by our more vivacious and more southern neighbors. Stands numbered 21, 22, and 23 in the Sedan Department of the French Section are quite a study in themselves, and deserve all the praise that can be lavished upon them. Sedan, though so recently trodden under foot, is still able to proclaim with Wallenstein that

> "There exists
> A higher than the warrior's excellence."

Then there are the standard Elbeuf cloths, made regardless of expense, which contribute to the clothing of a select few of "the upper ten thousand" both in their own and many other nations: it is the cloth, the "par excellence" of the *élite* of "genteel respectability" everywhere; but these cloths show nothing strikingly new in any feature, either of design or otherwise. There are very good exhibits from all, or nearly all, the other French seats of the wool industry; but perhaps one of the most remarkable is the exhibit of worsted coatings from Roubaix and the neighboring town of Tourcoing, which produced some most beautiful worsted coatings from "singles," and which are rapidly supplanting English makes from "two-folds" in many of the American and other markets. There is a remarkable softness, suppleness, brightness of color, and luster in these goods, arising in part, no doubt, from their different mode of spinning. There are many points about these cloths to which English manufacturers would do well to give heed.

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Among the kindly acts of the Protection Society, the colonists, upon their arrival in Algeria, were provided with suitable furniture, stores sufficient to last them until harvest-time, with agricultural implements, and grain for sowing the soil; and it is satisfactory to find that many of these colonists are now able to maintain themselves, and will become owners of their land when they have repaid the advances made to them in the time of their need.—*Illustrated Paris Univer. Exhib.*

## WOOLEN FABRICS AT THE PARIS EXHIBITION.

AFTER going the round of the Exhibition it is difficult to resist the conclusion that design, as applied to fancy woolen trowserings, has been all but stationary during the last few years. It cannot be that our foreign rivals have shot ahead of us in this particular, as there are too many traces all over the Exhibition that their cues, or ideas, have had an English origin. It may be that our chief designers in Britain, as well as those on the Continent, have given the lion's share of their attention to the more fashionable worsted fabrics, and to cloths suitable for suitings as distinguished from trowserings only. Whatever may be the cause of this apparent neglect of the cultivation of design in the trowserings we do not presume to say; we are unable to score the advance that it has been our wont to see as the result of a series of years. We content curselves with simply noting what, in our humble opinion, is the present state of design in relation to fancy woolen trowserings, without presuming to state in hard and fast lines what is the cause of it. That we leave for abler pens.

France, as the leading and summoning nation in this *Olympiad of Industry*, makes a fine display of woolen goods, and were it not for the national fondness for niceties of distinction, such as the drawing of the line between goods made of *carded* and *combed* yarns, the effect of the display would have been much more impressive. As it is, many goods that are for gentlemen's wear are mixed up with ladies' dress goods, and scattered about hither and thither, because they happen to be made of worsted, or "*combed yarn*." But there are few classifications in this mundane sphere but what have a dash of imperfection in them, and if the line had been drawn at gentlemen's wear it would have been subject to the same fault in degree, as the ladies are such free rangers in their choice of materials for dress, and such inveterate raiders, that they frequently cross the line and lay hold of materials previously used by gentlemen only, and fashion them into some graceful form of dress for themselves. Combed and carded yarns, however, make a distinction less compact than our own, and so cause the French goods to be shown at a considerable disadvantage. That time-honored seat of the French woolen industry, Sedan, has a splendid show, and, like most other seats of the old superfine cloth manufacture, has had to go more and more into fancy goods. The court where the Sedan goods

their lowness of price and good value. There are also a few higher grade cloths of considerable merit.

The Belgian exhibit of woolen fabrics is of very ordinary merit, and as we can say little in their commendation, we prefer to pass rapidly by them.

In retracing our steps from the Luxembourg exhibit at the extreme end of the building we quite inadvertently stumbled among the Australian woolen cloths, and involuntarily exclaimed, "Ah! friends, we thought you were dead years ago; but it is evident that you are still above the sod and 'carrying on the war with vigor.'" Yes, the same stiff old window-pane checks that we used to see in the infancy of the fancy trade, and which have become hoary in our memory. It is quite evident from these goods that Australia can grow wool much better than it can manufacture it.

As a contribution from the sister isle, the case of Messrs. Martin, Mahony & Brothers, of Cork, ought not to be passed without notice. It presents a cheery, rollicking look to those approaching it, and, after a careful inspection of its contents, we say what cannot always be said with truth, that most of the cloths will wear as long as their future owners will care to see them; and those who have a lot of touring, mountain-climbing, fishing, or boating before their eyes, may find among these cloths the material for their habiliments.

Reaching finally the West of England exhibit, and on again sliding our hands in among the soft folds of these cloths, we felt them to be as delicious as soothing, and as refreshing to our heated, jaded, and fevered touch as if we had laved our hands in cool spring water. The West is not beaten yet where quality, superiority of fabric, and excellence of finish are the test points of standard. But we were taken somewhat aback on our first visit to Hooper's stand; we were not prepared for so large a display and preponderance of fancy cloths and fancy colors; we could scarcely realize the fact that we were standing in front of a collection of West of England goods; yet, nevertheless, such was the fact. It would seem that such is the change in public taste that even West firms cannot sustain themselves solely upon the manufacture of superfine cloths. Stanton & Son, Salter, of Trowbridge, Trenchard, of Windham, Ritchie, of Stroud, and Carr, of Bath, are all here exhibiting cloth more or less noteworthy; but the cloth of Hooper, of Stonehouse, and Marling, of Ebley, are unapproached and unapproachable by anything in the whole range of the Exhibition, and wherever the honors fall these cloths are a fountain of honor to themselves, and are able to stand and maintain their peerless position quite independent of jurors' decisions. As specimens of high-class manufacture they are immeasurably above the reach of any rival, home or foreign.

Leaving the Champ de Mars, and crossing the river, we once more ascended the hill and mounted the steps of the Trocadero Palace, and, pacing its open gallery and gazing upon the fairy scene below and stretching away in front of us, wondered whether we should ever see its like again, till, necessity being upon us, we reluctantly and lingeringly quitted the scene, and ere sundown were speeding on our way with our faces to the north, till the Foreland Lights and the morning's dawn greeted us together across a "*choppy*" sea, and in due course we ascended the steps of the pier at Dover.

And now, after reaching our Northern home and endeavoring to realize the import of what we have seen, and while rejoicing at the progress and onward march of other nations, it is not unmixed with anxiety on behalf of our own; for, whether we like it or not, and whether we believe it or not, foreign competition is become too much a fact and problem of the day for us any longer to ignore it with safety. The necessity and obligation are both upon us to set about facing it like men, courageously and intelligently.

There may be, and we doubt not there are, the same economic causes at work in Continental society as among ourselves; but we have not seen them operating perhaps with the same degree of severity with respect to combinations, strikes, wages, and shortened hours of working on the part of the employed as in Great Britain. Nor, on the other hand, have we seen employers on the Continent rush headlong into reckless extensions of premises and into additions to the quantity of machinery far in excess of any legitimate demand, the effect of which in the United Kingdom has been to disturb and unsettle almost every trade in the country, and completely to derange the balance of the iron and coal trades, proving beyond question that both employers and employed need educating into a better knowledge of the conditions under which their best interests may be realized and consolidated. We cannot transgress with impunity the great economic laws any more than we can the laws of the moral or natural world: transgression and suffering are everywhere inseparable, and if we would escape the one we must study to avoid the other.

There are, nevertheless, some glorious chapters in the last fifty years of our national history, and therefore we will not complain. We have tunneled the mountain and leveled our iron path; we have traversed the ocean against wind and tide; we have commanded the lightning to go before us and speak our word from continent to continent the whole world round; and we have from 10,000 indicated horse power of steam in 1815 summoned to our aid to do our bidding no less a force than 12,000,000 indicated horse power, according to Sir W. Fairburn, in 1870, and he will be a bold man indeed who undertakes to say that we shall stand quite still during the next fifty years.

We will not look too gloomily at the present; but with improved elementary and technical education, and with a *more cultivated, quickened, enlarged,* and *refined taste* in design, will prepare with a manly courage to meet the future.—*Textile Manufacturer.*

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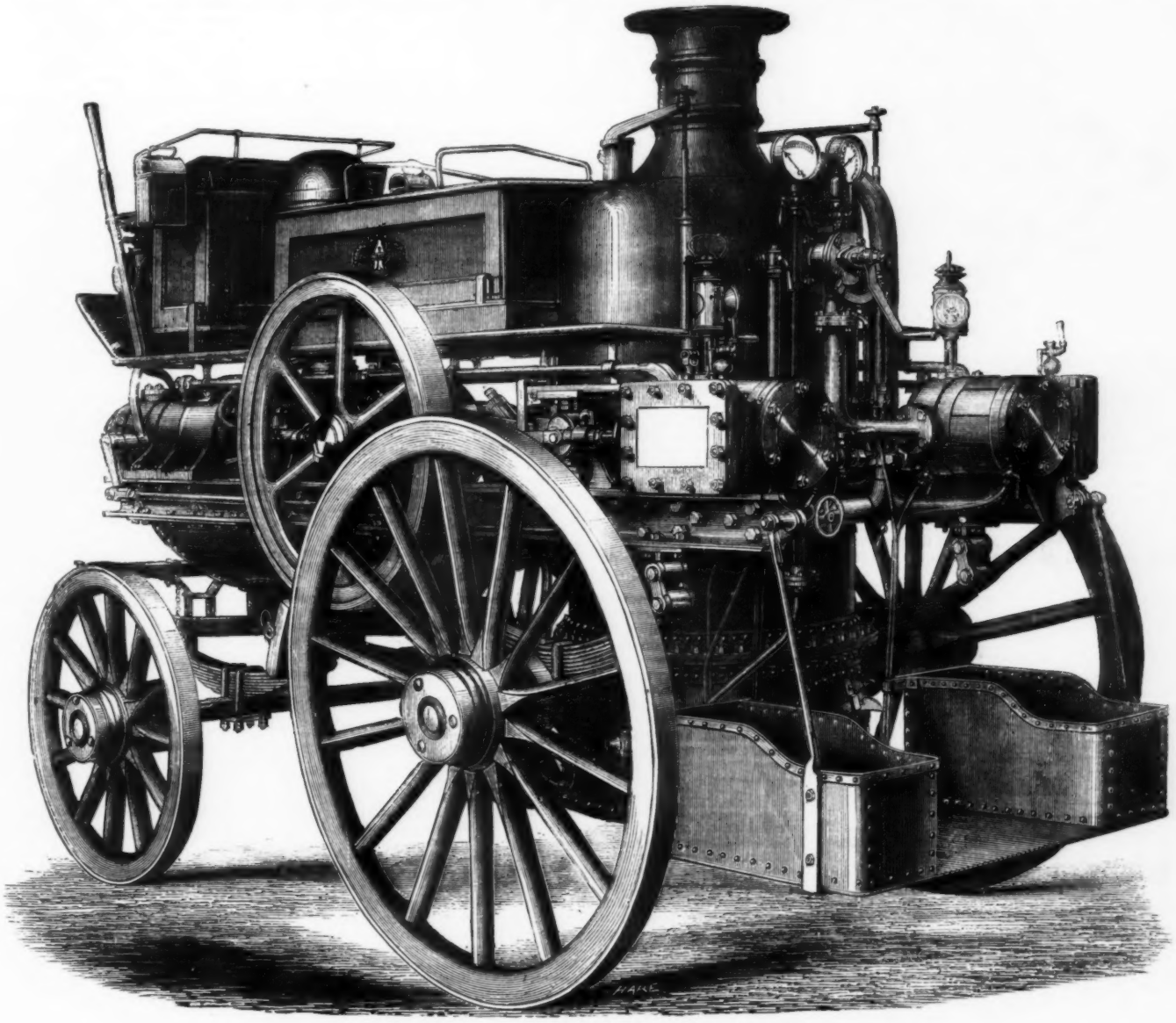
THE cry which was so loudly raised in the newspapers after the Thames accident for vessels which in case of collision would have more power to float, is meeting already with response, and an inventor has come forward with a scheme for an unsinkable ship. The plan has met with considerable favor in influential quarters, and a subscription has been made in London among about twenty merchants cooperating with the London Steamboat Company to give it a fair trial. The model vessel is already in frame, and some preliminary experiments will shortly be made. The invention is a very ingenious one, and is likely to prove at least partially successful.

## PORTABLE STEAM PUMPING ENGINE.

THE want of a powerful yet portable pumping engine, one that could get up steam quickly upon an emergency, and be useful for a variety of purposes, has long been felt by water companies. Mr. Rumble, engineer to the Southwark and Vauxhall Water Company, having found it necessary to make use of one of Shand, Mason & Co.'s steam fire engines for temporary pumping purposes, applied to that firm to carry out his ideas for the construction of an engine that would answer the desired purpose. The result is illustrated in the engraving, which shows the general construction of the machine. The boiler is on Shand, Mason & Co.'s patent inclined water tube principle, so successfully used by them in steam fire engines. It is placed vertically on two cross stays riveted on the boiler, and these are firmly bolted to the main frames, which are of rolled channel iron. It is stoked from the hind foot plate, on which are fixed the coal bunkers. The pumps are on their treble equilibrium principle, laid horizontally in the front, and firmly bolted to the framing. The suction and delivery passages are so arranged that no deposit can remain in these parts. There are two steam



PORTABLE STEAM PUMPING ENGINE.

cylinders, each 6 in. diameter with a stroke of 9 in., fixed in the framing by the side of the boiler. The pistons are connected to the outside cranks of a polished Bessemer steel crank shaft. The cranks for driving the pumps are in the center, and those to which the pistons are connected are at the outer ends. The web of each of these cranks is turned to form the eccentrics for driving the two feed pumps. The two eccentrics for distributing the steam with their cranks and other eccentrics are all one solid forging and turned in the lathe to their respective angles. It revolves in four plummer blocks fixed on the framing. The three pump connecting rods are made so as to be readily detached; by this means either one or more of the pumps can be worked separately. When completely disconnected it becomes a motive power engine, and capable of driving machinery by a band on the flywheel or on the rigger provided for the purpose. The whole is supported on springs, and can be drawn on good roads by two horses at a rapid rate. Steam can be got up and the engine put to work in the space of fifteen minutes, and has delivered 78,000 gallons per hour. This engine has been successfully used for emptying the reservoirs at Nunhead, for repairs and other purposes, such as emptying a dam in the Thames at Richmond giving access to the water company's mains laid in the bed of the river.—*The Engineer.*

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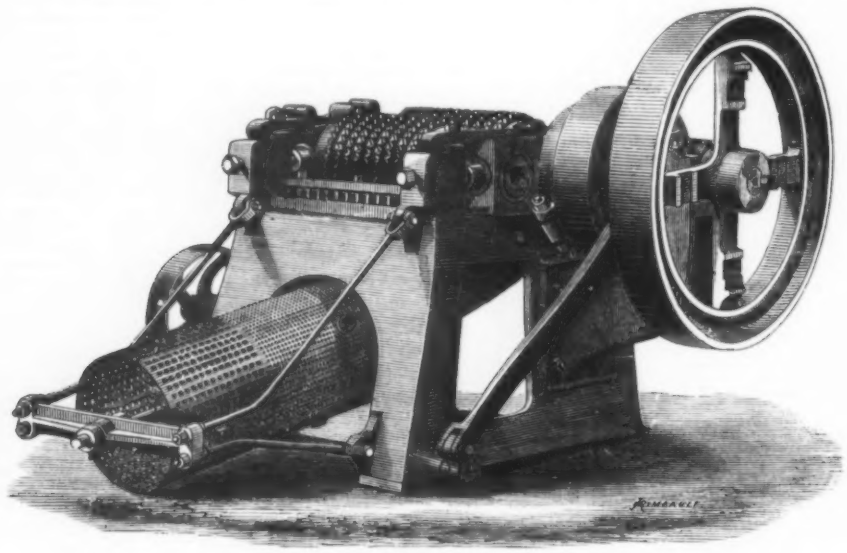
A VAST deposit of solid rock salt has been reached at Inowrazlaw.

## NEW BONE MILL.

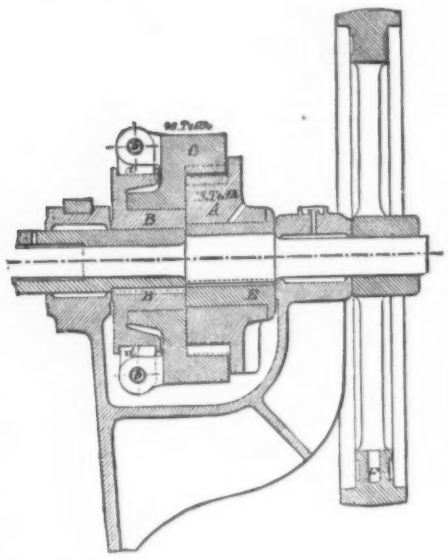
WE give a view of a new type of bone mill, by the Savile street Foundry Company, Sheffield, England, and which includes several improvements. We also annex a detail view, showing the arrangement of driving gear employed in this mill. An objection to the use of differential gear as employed in previous bone mills by these makers, was its vertical position, as at each revolution the whole weight of the pinion of the gear, together with the eccentric and tail lever, had to be lifted through a distance equal to the throw of the eccentric, and, at the high speed of 160 revolutions, this produced a rather jerky motion. It was, moreover, impossible to balance the weight lifted, as the roll was driven by friction band and sheave, so that the relative position of the flywheel and differential gear was always changing.



BONE CRUSHING MILL.

In the machine we now illustrate, however, this objection has been quite got over, as follows:

Referring to our detail view, it will be seen that the friction sheave, B, is keyed to the bottom roll or low speed shaft. The internal differential toothed wheel, C, is mounted loosely thereon, but has two lugs through which bolts, D, engage the friction strap, *d*. By tightening this strap the wheel, C, becomes the driver of the roll shaft, and when anything harder than bones gets in the strap allows the roll to stand while it is itself driven round. The wheel with external teeth, A, is mounted loosely upon the eccentric, E, which is keyed to the high speed shaft, and the flywheel outside is also keyed to this shaft, but is balanced at the periphery, F. The screen is suspended by light rods from the top and bottom of the machine, as shown in our engravings. The frame is a box-like casting all in one piece, and is without a single bolt in it for any bearings. The rolls are made to expand by screws so that large bones may be roughly broken, and the rolls then be set up and the bones finely crushed. The rings of teeth are fastened in an improved manner, and can be slipped off and on in a few minutes, and being made to gauge, will always fit without filing. Hard chilled shells can be put on instead of the toothed rings, so as to make the mill suitable for crushing coprolites, phosphates, etc.—*Engineering.*



## PICCARD'S BOILER.

### EXTRACTION OF SALT FROM SALT WATER.

AN improved boiler for the extraction of salt from salt water is exhibited in Paris by Messrs. Weibel, Briquet & Co., of Geneva. They have attempted to utilize the heat of the steam produced by the evaporation of the water in a first boiler by conducting it against the shell of another boiler containing salt water at a lower temperature than the first. The steam produced in the second boiler is brought in contact with the shell of a third boiler cooler than the second, and so on. This principle has long been applied to the apparatus employed in distilleries and sugar refineries. For solving the problem he had undertaken, Mr. Piccard, the inventor of this apparatus, was obliged to observe the two following conditions: In the first place, the apparatus must be hermetically closed, in order to prevent the escape of the steam obtained from the salt water; and secondly, the apparatus, though closed, must be so constructed as to allow the continual and regular extraction of the solid salt precipitated during the evaporation. The apparatus consists of a closed cylindrical boiler containing a hollow cylinder called the condenser. This latter contains only steam, and is entirely immersed in the saline solution. At the bottom of the boiler is a vertical tube provided with two hand valves, with a certain amount of space between them. The upper valve is usually open, while the lower one is generally closed. When steam is introduced into the condenser at a higher temperature than that of the solution, the condenser transmits this heat to the surrounding liquid, which is vaporized, while the steam is condensed. The condensed steam flows out by one tube, and the vapor from the solution escapes into another tube. The salt produced by the evaporation forms a crystalline precipitate, part of which falls to the bottom of the boiler, while the remainder adheres to the shell of the condenser, and is detached by scrapers, which slowly revolve at a short distance from the surface of the shell. After it has been detached, the salt falls to the bottom of the boiler, and is there carried by the rotation of the water to the tube mentioned above. As the upper valve is open it falls into the space between the two valves, and can be extracted by closing the upper and opening the lower valve. The admission of air into this tube is prevented by a trap filled with salt water.

## COMPRESSED AIR MACHINES.

COMPRESSED air is now largely used in mines and in tunneling in place of steam or water, the application of compressed air in tunneling through Mont Cenis by Sommeiller in the year 1857 being the first great work effected by its agency. It is now successfully applied in our mines in driving coal-cutting machines, hauling-engines, rock-drills, and pumping-engines.

The inconvenience attending the use of steam for underground engines is well known, not only from the condensation of steam, but from the difficulty in getting rid of the exhaust when the engine is placed at a distance from the upcast pit. The loss of power when ropes of great length are used for hauling amounts in some cases to 75 per cent. of the motive power. Hydraulic power is now used to some extent for pumping water in mines, with good results when a considerable pressure can be obtained; 700 lbs. was at one time considered to be the maximum working pressure, now 1,500 lbs. per square inch is not unusual. Assuming the compressed air to be at 40 lbs. pressure per square inch, and water at 700 lbs., it will be seen that to obtain the same result it will require about 17½ times more air than water, and the velocity through the pipes will be in the same ratio. The friction increases as the square of the velocity, therefore the friction of the air would be 306 times greater than that of water, and there would be 17½ times the quantity to deliver; the power required to overcome this and friction would be as the cube of the velocity, requiring a power 5,359 times greater than water. The density of the air, however, at 40 lbs. pressure is about 225 times less than that of water—then 306÷225=1·4 nearly more friction, and 5,359÷225=24 times greater power required with air than with water. This would be the result in pipes of the same size and length, but by increasing the size of pipe and reducing the velocity the practical difficulty in the transmission of air is to a great extent overcome. Water-power may be applied to a pumping-engine in a mine—say, with 300 lbs. pressure per square inch on the piston—to pump ten times the quantity expended in driving it, to an altitude of 69 ft., minus the friction of the engine and of the water in the pipes. This may in some cases be a convenient application of water power, but it is not generally applicable. But compressed air is not only suitable as an underground motive power, but also as an aid to ventilation. The air discharged from a pair of 14 inch hauling-engines, at 120 strokes per minute, and 30 lbs. pressure, would be about 2,000 cubic feet per minute, and this would be at a low temperature, about freezing point, so that it would have a most beneficial effect in cooling the air and augmenting the current in the working part of a mine, where it is most needed.

The advantage claimed for hauling-engines actuated by compressed air is that they can be placed at the furthest extremity of a mine, and moved from place to place as the circumstances of the mine may require them for convenience of haulage by ropes or for pumping water. The useful effect obtained from compressed air-engines is small, but this will evidently vary with the length and size of the air-pipes, the construction of the air-compressor, and the condition of the hauling-engine. As much as 65 per cent. of useful effect is stated to have been obtained in the working of one of the hauling-engines at Ryhope Colliery, Durham. The steam-engine on the surface consists of a pair of 32-in. cylinders, 5-ft. stroke; average pressure, 15 lbs., giving out a power of 78-horse, after deducting its friction. The distance from this engine to the underground hauling-engine is about 1,500 yards; the power given out by this is 51-horse, without deducting the friction of its own parts. The air-compressors at bank are a pair of 33-in. cylinders, 5-ft. stroke, cylinders and covers jacketed; in the space between the cylinders and jackets a circulation of water is maintained. The useful effect obtained from compressed air in other cases is stated to be only 30 per cent., or 20 per cent. of the motive power; but the latter may be due, in a great measure, to imperfect machinery, and limitation in the area of the pipes. It is well known that when the air is being compressed, great heat is given out from the compressor; it is to prevent this loss of power that the cylinders are jacketed and cooled with water. The temperature of the air at the outlet of the compressor at Ryhope was 212°. The temperature of the air at the receiver at the bottom of the pit was 74°, and the pressure 44 lbs. The temperature at the receiver near the hauling-engine was 58°, and the pressure averaged 38 lbs., the engine being in motion most of the time.

Another cause of loss of useful effect is due to the outlet orifice of the compressor being so constructed that the compressed air cannot escape freely from the cylinder, neither can the air enter freely into the cylinder for compression. It has been proposed to inject cold water into the compressor in the form of spray, to keep the temperature nearly uniform, and prevent the great increase of volume by heat, which compression always occasions. This expedient may be said to favor the formation of ice at the exhaust orifice of the hauling-engine, but this could be prevented by injecting water at the ordinary temperature into the cylinder of this engine also, and enlarging the orifice, so that practically no difficulty would arise from this cause. If the quantity of water injected were such as to keep the temperature nearly uniform in the compressor, and the same in expanding at the orifice of the hauling-engine cylinder, the loss of power that arises from the air heating and cooling would be much reduced; and the practical loss would be in the machinery and in the passage of the air through the pipes.

Authorities differ much as to the useful effect obtainable from air compressing machines. As this must depend on various conditions already alluded to—the valves of the compressors, the machinery, size of pipes, etc.—if these were constructed on the best principles the loss of power would not be so great as some state it to be—75 per cent., whereas others give the useful effect as 65 per cent., or a loss of 35 per cent. only. The application of compressed air to driving hauling engines underground has been largely carried out at the Powell Duffryn Collieries in South Wales. The steam cylinders are 34 inches diameter, the compressors 40 inches diameter, with 6-feet stroke; steam pressure, 70 lbs., cut off at one-fourth; air compressed to 40 lbs. above the atmosphere. The engines make 20 revolutions per minute, and indicate 480 horse-power. There are 26 hauling-engines driven by compressed air at the Powell Duffryn Collieries in three different sizes. First, for the main roads the engines have two 12-inch horizontal cylinders, 12-inch stroke, geared in the ratio of 1 to 5, with two drums 4 feet in diameter. Second, for the branch roads single cylinder engines are used of similar construction to those above, with 14-inch cylinder, 12-inch stroke and two drums. Third, the portable hauling engines, the extreme dimensions of which are—Length, 6½ feet; breadth and height, 4 feet. Each has one cylinder 8 inches diameter, 9-inch stroke, geared in the ratio of 1 to 6, with two drums of 2 feet diameter. This engine can be moved about on the roads, being provided with four wheels for the purpose. The latter engines are intended to supersede the ponies and boys employed in bringing coal from the workings to the branch roads. Experiments made with the air-compressors and engines show that the greatest useful effect is obtained with low pressures.

| | | | | | | |
|---|---|---|---|---|---|---|
| At 40 lbs. | pressure | of | air | the | useful effect was | 25·8 per cent. |
| " 34 | " | " | " | " | 27·1 | " |
| " 28½ | " | " | " | " | 28·5 | " |
| " 24 | " | " | " | " | 34·9 | " |
| " 19 | " | " | " | " | 45·8 | " |

—*M. E. in Mining Journal.*

## THE ST. GOTHARD TUNNEL.

By GEO. J. SPECHT, C.E.

THE building of the Mont Cenis Tunnel through the Savoy Alps to France, and the Brenner-road to Austria, have made it absolutely necessary for Germany and Switzerland to choose between losing the commerce and travel of the South and building a mountain railroad. Of the stage routes crossing the passes of the Alps, only four were found which could be followed by a railroad, viz.: the Septimer, Splügen, Lukemanier, and St. Gothard Passes.

For the St. Gothard Railroad, three lines were projected, with the following results:

| PROJECT | I. | II. | III. |
|---|---|---|---|
| Length of tunnel, feet, | 35,030 | 48,544 | 50,413 feet |
| Length of tunnel, miles | 6·63 | 9·19 | 9·55 miles |
| Highest point of line, feet | 4,797 | 3,785 | 4,187 feet |
| Highest point reached by open line | 4,772 | 3,690 | 3,969 feet |
| Time required for constructing it, years | 11 to 12 | 15 to 16 | 15 to 17 years |
| Estimated costs | 7,800,000 | 10,600,000 | 11,000,000 dols. |

Project No. II. has been adopted, and is the one now in course of construction. It has been selected on account of its being the lowest above sea level; the object being to avoid snow blockades in winter. This selection is in so far interesting, as we have some cases in point on this coast. We refer to the obstructions in the rocky mountains of the Sierra Nevada, the summit of which is passed by an open line, instead of a tunnel.

The contract for the St. Gothard Tunnel is the most interesting. It was granted to Louis Favre, of Geneva, he being the lowest bidder of twenty-three competitors, and his bid $196.40 per foot of tunnel, complete. By the terms of the contract, Mr. Fevre promises to deliver the works of the tunnel, completed, in eight years, viz.: by the 1st October, 1880. For each day the work may be done before that time, the company agrees to pay him $1,000. On the other hand, however, for every single day in arrear of contract he forfeits $1,000. If delay continues six months, the forfeit is $2,000 per day; and should he be one year in arrear with his work, he surrenders the contract and forfeits $1,600,000, which he and his friends for him have deposited with the company as security. The contractor calculates to

make a profit on this premium, rather than on the work itself.

The northern entrance of the tunnel is situated near the small village of Goeschenen, in the Canton Uri, in the German speaking part of Switzerland; its height above sea level is 3,637 feet. The southern entrance is near the village of Airolo, in the Italian speaking Canton Tessin, and its height is 3,756 feet. It is the largest tunnel of the world, and exceeds in length that of the Mont Cenis, the Hoosac, and the Sutro tunnel. The total length of the Mont Cenis is 40,084 feet, or 7·6 miles, the Hoosac, 25,040 feet, or 4·74 miles, and the Sutro tunnel, 20,370 feet, or 3·84 miles. The strata of the rock have mostly been gneiss and mica slate, also granitic gneiss and quartz.

The grade of the tunnel, beginning at the northern entrance, is 5·82 feet in 1,000 feet, or 30·7 feet per mile, for a length of 24,459 feet, raising the line to a height of 3,785 feet above sea level. The line is then level for 590 feet, and is then descending one foot in 1,000 feet, or 5·28 feet per mile, for a distance of 20,628 feet. This grade has lately been changed to 2·5 feet in 1,000 feet or 13·2 per mile. The tunnel has a double roadway, and it is probable that it will be arched from beginning to end.

In regard to the mode of construction, the following may be of interest: The French or Belgian system of building railway tunnels is to lay the advance drift in the top of the cut, while the system of placing it at the bottom is more frequently employed in Germany, Switzerland, Italy, etc. In this case the latter method had been projected, but it was left to the option of the contractor. He has seen fit to locate it at the top, which has been to some extent a cause of delay. The advance drift is 8·2 feet square. About 600 feet behind it two segments, one on each side of the axis, were excavated, thus giving space to the whole width of the arch. In the rear of these side cuts another one is following on the east wall, about 12 to 15 feet below the floor of the header. The latter is 9·8 feet wide, and is worked in two sections, one above and the other below. In some places, where the nature of the rock requires it, the arches were built, as the side cuts were finished; but generally this is done after the sole cut on the left side has been completed. The arch is on one side supported by the ramp, and on the other temporarily by timber. After excavating the ramp the sustaining walls are erected, and the tunnel completed.

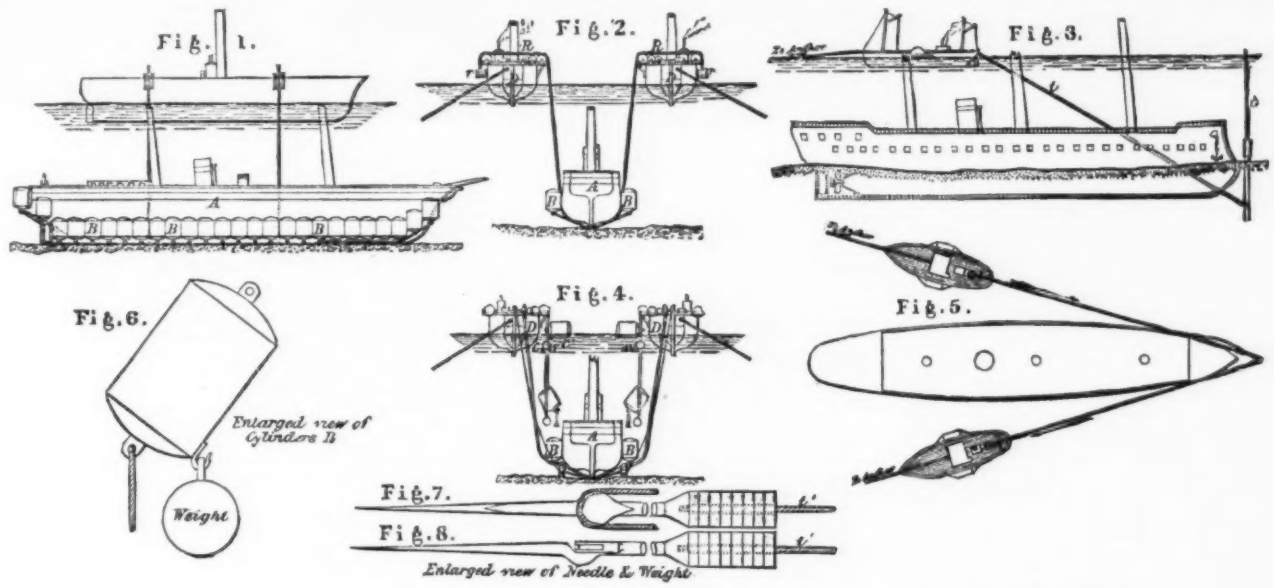
The header is about 67 square feet, and is worked by machines. The car carries six drills, and eighteen more are kept on hand. They are worked by compressed air. The number of holes bored per lineal meter (3·28 feet) has been 13 to 20, each hole being from 3·28 to 3·94 feet deep, and 1·5 inch in diameter. In granitic gneiss 23 holes per meter (equal to 8·11 cubic cards) were required, while only 14 holes were necessary in mica slate. Repairs for the same progress have been 1·33 drill in granitic gneiss, but only 0·16 drills in soft rock. For the same progress, from 38 to 292 drill required sharpening, the number varying according to the nature of the rock. The drills used were the McKean, the Winchester, and the celebrated Burleigh drill (American). Sixteen hands are employed on the car. After the boring is done the car is moved to the next switch or to a safe distance, say 90 to 130 feet, and then covered with boards to protect it against damage. The blasting is intrusted to two men. Each hole is charged with 7 to 12 cartridges, weighing 3·1 ounce each, except the prime, which weighs 1·3 ounce. For one cubic yard of granitic gneiss, 8·82 lbs. of giant powder, 29·7 feet of fuse, and 3·92 caps were used; while in mica slate only 4·6 lbs. of giant powder and 20·2 feet of fuse were required. The tamping has been very little, sometimes none at all. Blasting by electricity has been tried, but the usual way has been found preferable. The holes are not blasted at once. The holes above are blasted first, those in the center next, and the remaining afterwards.

The side cuts have an average surface of 77 square feet. They were formerly worked by hand, but now machines are used. The cars employed here are lighter, and carry but four drills, besides which twelve are kept in reserve for each car. The method of working is the same as in the header. In granitic gneiss 16 to 20 holes were bored per lineal meter: in mica slate 10 to 14 holes, each hole being 3·28 to 3·95 feet deep, and 1·6 inch in diameter. For excavating one cubic yard in mica slate, 4·33 lbs. of giant powder and 9·3 to 15·1 fuse were used; in granitic gneiss 5·07 to 5·59 lbs. of giant powder and 15·1 to 20·2 feet of fuse were required. On each side cut ten or twelve men are employed. The sole cut, as has already been stated, is worked in two sections. The upper section is about 54 square feet, and the lower one has a surface of 65 square feet. The mode of working is the same as in the side cuts. Six drills are used, which are mounted on a car of very solid construction. For each car eighteen reserve drills are kept on hand, and 13 men are employed.

The sections which then remain to be excavated are the following: The arch section of 40·9 to 45·21 square feet; the abutment section of 58·13 square feet; and the ramp, of 207·74 square feet. The work here is done by hand, and the number of men employed is varying, as the nature of the work may require.

## APPARATUS FOR LIFTING SUNKEN VESSELS.

WE illustrate a proposed mode of raising sunken vessels, which has been designed and patented by Mr. Thomas Archer, Jr., of the Dunston Engine Works, Gateshead-on-Tyne, England. The mode of operating proposed by Mr. Archer consists in the attachment of a series of buoyant cylinders or pontoons, B, Figs 1 and 2, each of which is to be sunk by a weight attached to it, this weight being subsequently drawn to the surface again after the pontoon has been attached to the wreck by the diver. Fig. 6 shows the manner in which the weights are to be slung to the pontoons so as to tilt the latter into a convenient position for being dealt with by the divers. One of the chief features of Mr. Archer's plans is the means adopted for passing ropes under the vessel when the latter is embedded in a muddy or sandy bottom. This arrangement consists in the employment of what Mr. Archer terms "needles," or long sharp-pointed piles, such as are represented in Figs. 7 and 8. The needle has a recess on one side adapted for holding the bight of a steel coiled rope, as shown, and Mr. Archer proposes to drive one of these needles, with the wire rope in place, into the bottom ahead of the vessel, as indicated in Fig. 3. The "needle" has a wire rope attached to its head, and the driving is to be accomplished by weights slid down this rope. When the needle has been driven so as to carry the rope sufficiently far down into the bottom, it is to be withdrawn, and the rope pulled under the bottom of the vessel by tugboats hauling at either end, as shown in Figs. 3 and 5, these boats going ahead and astern alternately, so as to give the rope a sawing motion. In case of wear of the rope, Mr. Archer proposes that one tug shall pay out a first length and the other haul in, so as to bring a fresh portion of the rope on to the sand. One rope having been got under the bottom, others can of course be made to follow. In Fig. 2, the lifting of the vessel when made almost buoyant by the attachment of the pontoons, B, is shown as being controlled by what Mr. Archer names regulators, these being ropes led over the lifting vessels, D D, and attached to weights which descend on the other side of these vessels as the wreck is raised, brakes being provided to control the descent of these weights. The weights, D, are intended to start the vessel from its bed and supplement lifting power of the pontoons, B.




APPARATUS FOR LIFTING SUNKEN VESSELS. BY THOS. ARCHER, JR.

## RUSSIA SHEET IRON.

FOR a long time the method of manufacture of Russia sheet iron was held as a secret, and though this leaked out many years ago, so far as the general principles involved were concerned, yet there were details of manipulation which resisted the ingenuity of manufacturers, and which could not be reproduced by the use of machinery infinitely superior to the crude appliances by which the genuine Russia sheet is manufactured. Since many persons still think the method of manufacture a mystery, says the London *Iron Trade Exchange*, a description of it will be of interest to many of our readers.

Professor S. Jordan, of the Ecole Centrale, in Paris, who is also president of the Institution of Civil Engineers in France, and one of the leading authorities on iron and steel, gives, in his report on the iron industry at the Paris Exhibition in 1867, some details of the manufacture of Russia sheet iron, which, he says, were furnished to him by M. Koulibine, a Russian engineer. These polished sheets are manufactured from charcoal iron, produced in finery fires and brought into the form of blooms about one inch thick. These blooms are heated to cherry heat and rolled into leaves. Each of these leaves is cut into pieces corresponding to the weight of the sheets which are to be manufactured, and these pieces are piled upon one another and rolled together until the desired degree of thinness is attained. Thus the black sheets are manufactured. To transform these into polished sheets, a certain number at a time are heated to red heat and piled one upon another, a black impalpable powder, which is simply pulverized charcoal, being sprinkled between each two sheets. The bottom and the cover of each packet of sheets thus piled for polishing are formed by two sheets of greater thickness. This packet is then hammered for the purpose of reducing the sheets still further in thickness, under a hammer, the head of which weighs from 1,000 to 1,100 kilogrammes (say, 2,200 to 2,400 lbs.). For giving polish and lustre, the sheets, now almost cold, are brought under a second hammer with a large face, rounded at the edges and of the same weight. Finally they are allowed to cool completely, and are then clipped and classified into three classes, according to the perfection of their polish. The sheets of the first class ought to be like a mirror, without a spot upon their surface. The action of charcoal projected upon the red-hot surfaces, and inclosed between them without access of air, may be easily understood. It cements, and thus enables them to take a high polish, while rendering them at the same time less liable to rust. This cementation once having taken place, the sheet should not afterward be returned to the heating furnace. Whether the non-oxidizable quality is due to a carburation of the surface by cementation or by an oxidation which has been supposed to take place in the somewhat tedious process of manufacture, is not yet fully decided. The high quality of the iron used by the Russians has no doubt much to do with the merited popularity their final product enjoys. In the same category is the fact that, while we make most excellent wire from our own iron, we have not yet been able to produce an article quite equal to the Swedish rods for certain purposes. We have no doubt but that in time the American product, or "imitation Russia," which is now perfectly adapted to many uses, will eventually be made equal in all respects to the genuine Russian and exclude it from our markets; but this result will only be accomplished by greater care and skill in manufacture.

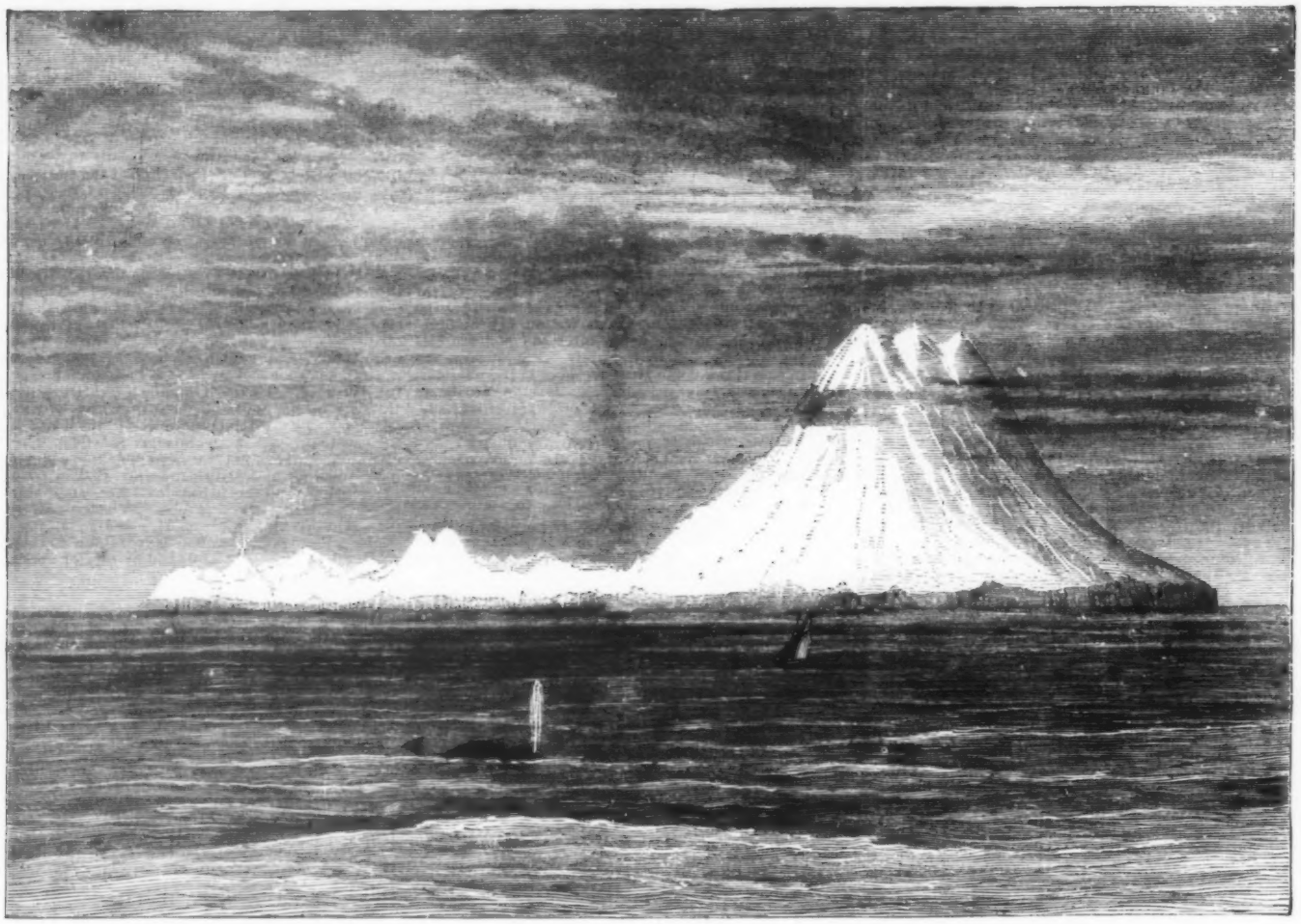
## MANUFACTURE OF ARTIFICIAL STONE.

FOR this purpose a mixture of liquid chloride of magnesium of 25° to 30° Baumé and calcined magnesia is used as a vehicle for binding together the particles forming the artificial stone. Both articles are mixed while cold, so as to form a plastic mass. With this magnesia cement all neutral matter or colors may be mixed, so as to form a conglomerate of great cohesion, which, as the mass is plastic, can be used for producing articles of most any shape and description. For making emery wheels, emery flour of any number may be used. The mass dries perfectly in three days. Grindstones may be made by incorporating sand, sandstone in small pieces, quartz, with the cement, bringing into proper shape, and exposing to the air for some time. For millstones the refuse and breakage of the natural ones may be used.

For the production of artificial marble, fragments of natural marble are well united by the cement. All desired combinations and all patterns may be easily obtained. When pure bleached and carded cotton is mixed with the magnesia cement, an elastic, very firm mass is obtained, which can be shaped at will while soft, but which hardens soon and forms a compact, pearly white mass, which can be turned on the lathe and carved like ivory. It is well adapted for making billiard balls. In the same way a variety of materials may be obtained by incorporating small pieces of glass, minerals, pieces of metal, organic substances, etc., with the cement.—*Deutsche Gewerbe Zeitung.*

## COMPRESSED FUEL.

THE London correspondent of *Saunders* writes: Before long it would seem we shall have every necessary of life in a compressed form. We have compressed hay, meat, tea, coffee, and milk; and now we are invited to do away with coal and go in for compressed peat. It has already been tried on the Belfast and Northern Railway of Ireland, and the engineers of that line state that 21 pounds of peat raised steam for a mile of running, while it took 26 pounds of coal to do the same work. For domestic purposes, when prepared by the new process of compression, it claims the advantage of being almost smokeless, free of surplus, clean to hands, distributing pleasant smell, maintained heat, and can be supplied at half the price of coal. In the manufacture of gas, as compared with coal, its illuminating powers are tested, and put down as 342 to 100. A charcoal is also manufactured from the peat and is being largely adopted for agricultural purposes.



THE PEAK OF BEERENBERG, SPITZBERGEN.

## THE DUTCH ARCTIC EXPEDITION.

The Arctic exploring ship, Willem Barentz, which left Amsterdam on May 5, touched at Vardö on July 19, in order to land dispatches. Hitherto the Dutch Arctic "trial trip" has been as successful as its numerous well-wishers could desire. The Willem Barentz has been at Jan Mayen, Spitzbergen, and Bear Island, falling in with the "ice-pack" in lat. 78 deg.; and, though the weather has not been favorable, only three fine days being recorded up to the middle of July, many important scientific observations have been made; a memorial stone has been erected on Amsterdam Island; and all on board seem full of zeal, health, and good spirits. The return of the expedition may be looked for in October, when, if all goes well, they will have visited the Barentz and Kara Seas, and will have done as much as possible in the limited time at their disposal to advance the cause of science. The Willem Barentz was off Jan Mayen on June 9, which was one of their three fine days, so that the members of the expedition had a good view of the whole island, a sight which very few of their predecessors have enjoyed, the high land being as a rule shrouded in mist. This curious island was discovered by Henry Hudson in 1607, and by him named "Hudson's Tutches;" it was afterward improperly called Jan Mayen, after a Dutch skipper who was said to have seen it in 1611. It is thirty miles long by nine broad, and at the north end rises the remarkable volcanic peak of Beerenberg, 6,870 ft. high. On June 9 this peak was covered with snow almost to the water's edge, and presented a most imposing appearance, the high, jagged summits of the lower hills, from one of which smoke was slowly rising, being quite dwarfed by comparison. The accompanying view is from an outline by Mr. W. J. A. Grant, who served with Sir Allan Young in the Pandora in 1876, and is the only English member of the present Dutch expedition. The Willem Barentz is a small sailing schooner of eighty tons, built and equipped at Amsterdam by a few private subscribers, without Government aid. She is commanded by Lieutenant J. J. De Bruyne, a Dutch naval officer, with Lieutenant Koolemans Beynen and H. M. Speelman, as second and third in command, with three or four scientific men, and a crew of eight sailors.—*Illustrated London News.*

## ON THE SCIENCE OF EASY CHAIRS.

There is reason in everything, if we can only find it out, but it is sometimes very hard to discover the reasons of even the very simplest things. Every one who has traveled much, and even those who have merely looked through books of travels, must have been struck by the variety of attitudes assumed by the people of different countries. The Hindoo sits down on the ground with his knees drawn up close to his body, so that his chin will almost rest upon them; the Turk squats down cross-legged; the European sits on a chair; while the American often raises his legs to a level with his head. Nor are the postures assumed by the same people under varying circumstances less diverse. Climate or season, for example, will cause considerable alteration in the posture assumed, as was well shown by Alma Tadema, in his pictures of the Four Seasons exhibited in the Academy a year ago. In his representation of Summer he painted a woman leaning backwards on a ledge, with one leg loosely hanging down, while the other was drawn up so that the foot was on a level with the body. In the picture of Winter, on the other hand, we saw a figure with the legs drawn up in front of the belly. The reason for these different postures has been explained by Rosenthal. The temperature of the body, as is well known, is kept up and regulated by the circulation of the blood through it, and a great proportion of the blood contained in the whole body circulates in the vessels of the intestines. Now the intestines are only separated from the external air by the thin abdominal walls, and, therefore, any change of temperature in the atmosphere will readily act upon them, unless they be guarded by some additional protection. The Hindoos are well aware of this, and they habitually protect the belly by means of a thick shawl or cummerbund, thus guarding themselves against any sudden change of temperature. This precaution is also frequently adopted by Europeans resident in hot climates, and is even retained by them after returning to England. But the function of the cummerbund may, to a certain extent, be fulfilled by change of posture alone. When the legs are drawn up, as in the picture of Winter already referred to, the thighs partially cover the abdomen, and taking the place of additional clothing, aid the abdominal walls in protecting the intestines and the blood they contain from the cooling influence of the external air.

Thus it is that in cold weather, when the quantity of covering in bed is insufficient, persons naturally draw up their legs towards the abdomen, so as to retain as much heat as possible before going to sleep. In hot weather, on the contrary, they wish to expose the abdomen as much as possible to the cooling influence of the atmosphere. The posture depicted by Alma Tadema is the most efficient for this purpose. It no doubt answers the purpose to lie down flat on one's back, but in this position the abdominal walls are more or less tight, whereas, when one of the legs is drawn up as in the painting just alluded to, the walls are relaxed, and, the intestines not being subject to any pressure, the blood in them will circulate more rapidly, and the cooling process be carried on more effectually. In this attitude also the thighs are completely separated and loss of heat allowed from their whole surface.

Varying conditions of fatigue also alter the postures which people assume. When slightly tired one is content to sit down in an ordinary chair in the position of the letter N with the middle limb horizontal. As we get more and more fatigued we usually assume positions in which the limbs of the N become more and more oblique, the trunk leaning backwards and the legs extending forwards. If we lie down in bed on our back the legs will probably become straight, but if we rest upon our side they will be more or less bent. The straightness of the legs in the supine position is simply due to their weight, which is then supported at every point by the bed, but when we lie on our sides the genuflection of the legs is most agreeable, because not only are the muscles more perfectly relaxed, but, as the late Prof. Goodsir pointed out, the bones which form the knee joint are slightly removed one from another, and thus the joint itself, as well as the muscles, pass into a state of rest. Some of the bamboo easy chairs manufactured in India allow us to obtain the advantages of both positions. These chairs are made in the form of a somewhat irregular straggling W, and in them one can lie on one's back with every part of the body thoroughly supported, and the knees bent in the same way as they would be if one lay upon one's side.

Thus simple inaction, the relaxation of muscles, and the laxity of joints, are some of the factors necessary for complete rest, and an easy chair, to be perfect, must secure them all.

But it is possible for an easy chair to secure all these, and yet be imperfect. We have just said that usually, as the fatigue becomes greater and greater, the tendency is to assume the position of the N with the limbs at a more or less obtuse angle, but when sitting in an ordinary chair we find relief from raising the feet by means of a footstool, although this tends to make the angles of the N more acute instead of more obtuse. Still more relief, however, do we obtain when the legs are raised up on a level with the body by being placed upon another chair, or by being rested on the Indian bamboo seat already described. If, in addition to this, the legs are gently shampooed upward, the sensation is perfectly delightful, and the feelings of fatigue are greatly lessened. To understand how this can be, it is necessary for us to have some idea as to the cause of fatigue. Any muscular exertion can be performed for a considerable time by a man in average health, without the least feeling of fatigue, but by and by the muscles become weary, and do not respond to the will of their owner so readily as before; and if the exertion be too great, or be continued for too long a time, they will ultimately entirely refuse to perform their functions. The muscle, like a steam engine, derives the energy which it expends in mechanical work from the combustion going on within it, and this combustion, in both cases, would come to a standstill if its waste products or ashes were not removed. It is these waste products of the muscle which, accumulating within it, cause fatigue, and ultimately paralyze it. This has been very neatly shown by Kronecker, who caused a frog's muscle, separated from the body, to contract until it entirely ceased to respond to a stimulus. He then washed out the waste products from it by means of a little salt and water, and found that its contractile power again returned, just as the power of the steam engine would be increased by raking the ashes which were blocking up the furnace and putting out the fire. These waste products are partly removed from the muscles by the blood which flows through them, and are carried by the veins into the general circulation. There they undergo more complete combustion, and tend to keep up the temperature of the body. At the same time, however, according to Preyer, they lessen the activity of the nervous system, producing a tendency to sleep, and in this way he would, at least to some extent, explain the agreeable drowsiness which comes on after muscular exertion. It would seem, however, that the circulation of the blood is insufficient to remove all the waste products from the muscles, for we find that they are supplied with a special apparatus for this purpose. Each muscle is generally ensheathed in a thin membrane, or fascia, and besides these we have thicker fasciæ ensheathing whole limbs. These fasciæ act as a pumping apparatus, by which the products of waste may be removed from the muscles which they invest. They consist of two layers, with spaces between. When the muscle is at rest these layers separate, and the spaces become filled with fluid derived from the muscle, and when the muscle contracts it presses the two layers of its investing sheath together, and drives out the fluid contained between them. This passes onward into the lymphatics, where a series of valves prevent its return, and allow it only to move onward, till at last it is emptied into the general circulation.

In strong and healthy people the veins and lymphatics together are quite able to take up all the fluid which the arteries have supplied to the muscles, and thus prevent any accumulation from taking place either in them or in the cellular tissue adjoining them, or at least prevent any such accumulation as might become evident to the eye. In delicate, weakly persons, or in those who suffer from certain diseases of the vascular system, this is not the case; and after standing or walking for a long time the legs become swollen, so that the boots feel tight, and sometimes even a distinct impression may be remarked at that part of the ankle which was covered by the boot. In such persons we can actually see the swelling disappear, after the feet have been kept rested for some time on a level with the body, and it may be removed more quickly still by gently and steadily rubbing the limbs in one direction from below upward. It is almost certain that what we thus see in weakly persons occurs to a

slighter extent in all, and that even in the most healthy person after a long walk a slight accumulation of fluid, laden with the products of muscular waste, occurs both in the muscles themselves and in the cellular tissue around them, even although we cannot detect it by simple inspection. So long as the limbs of such a person hang down, the force of gravity retards the return both of blood through the veins and of lymph through the fasciæ and lymphatics, and thus hinders the muscles from getting rid of those waste products which caused the fatigue. When the legs are raised, this hinderance is at once removed, both blood and lymph return more readily from the muscles, carrying with them those substances which had been formed by the muscles of the limbs during the exertions which they had undergone when carrying the body about. So long as these substances remained where they had been formed, they might cause in the muscles of the legs an undue amount of fatigue, although when distributed over the body generally, they may produce only a pleasing languor. When the legs are long, the obstruction to the return of blood and lymph is, of course, greater than when they are short, and this return will take place more readily when the legs are raised above the body than when they are only on a level with it. This may be one of the reasons why some of our long-legged American cousins are so fond of raising their feet to a level with their heads, or even higher, although it is very probable that there are reasons still more powerful, which we may discuss at a future time.

It has already been mentioned that the lymph is propelled along the interstices of the fasciæ into the lymphatic vessels by the intermittent pressure which the muscle exerts upon them from within, and it seems natural to suppose that the flow may also be aided by a pressure from without, in the form of shampooing. Even when the hand is rubbed backward and forward upon the leg it will relieve fatigue, but the relief is greater when the leg is firmly grasped and the hand moved gently upward so as to drive onward as much as possible any fluid which may have accumulated in the limb, and the grasp being then relaxed, the same process should be repeated.

But while the lymph is thus most readily removed by the pumping action of intermittent pressure, either of the hand without or of the muscles alternately contracting and relaxing within, it seems to us probable that this process may also be aided by steady, constant pressure from without. No doubt it is impossible for such a steady pressure to take the place of the regular pumping action produced by the alternate contraction and relaxation of the muscles when in action, yet it will have a somewhat similar action, though to a very much less extent. For at each beat of the heart, as Mosso shows, the entire limb is distended by the blood driven into the vessels, and during the pauses between the beats it again becomes smaller. Each pulse, therefore, by distending the whole limb and each individual muscle will press out a little of the fluid contained in the fasciæ in the same way as the contractions of the muscles themselves, and it seems to us probable that it is the aid which is afforded to this process by the gentle pressure exerted on the outside of the legs by a seat which supports them along their whole extent that renders such a seat so peculiarly restful and agreeable. For an easy chair to be perfect, therefore, it ought not only to provide for complete relaxation of the muscles, for flection and consequent laxity of the joints, but also for the easy return of blood and lymph not merely by the posture of the limbs themselves, but by equable support and pressure against as great a surface of the limbs as possible.

Such are the theoretical demands, and it is interesting to notice how they are all fulfilled by the afore-mentioned chair in the shape of a straggling W, which the languor consequent upon a relaxing climate has taught the natives of India to make, and which is known all over the world.—*Nature.*

## A NEW PROCESS FOR SEPARATING IODINE AND BROMINE FROM KELP.

To overcome several disadvantages incurred in separating iodine and bromine from kelp according to the old Wollaston method, by means of sulphuric acid and peroxide of manganese, Prof. Galloway, of Dublin, proposes to substitute chlorine for those agents.

In working according to the Wollaston method, the residue remaining after distilling of the two elements was thrown away. The loss caused thereby sometimes constituted as much as fifty per cent of the entire cost of production. In using chlorine, Galloway proceeds as follows:

The solution of kelp is first perfectly neutralized by sulphuric acid. This is done, as kelp invariably contains a quantity of alumina, which renders the solution mucilaginous and unfit for crystallization, and Galloway recommends, therefore, perfect neutralization. The solution of kelp is then evaporated down till the chloride of potassium formed is nearly completely crystallized out. The mother liquor is then again neutralized, and an exactly measured quantity is well mixed, in a graduated pipette, with a small quantity of bisulphide of carbon. Then chlorine water is added in small quantities, till the violet color has completely disappeared. This test, so often used to determine iodine quantitatively, only takes up one or two minutes' time. After correctly noting the quantity of chlorine necessary to convert the iodine into chloride of iodine, the quantity of chlorine water necessary for the entire quantity of mother liquid is measured out and added to the latter. The small quantity of iodine remaining in solution can be extracted by benzole of bisulphide of carbon. After extraction of the iodine, the bromine is separated in a similar manner, three times as much chlorine water being required as for the separation of iodine.

Sometimes it is desirable not to dilute the liquid as much, as this would be the case by the addition of the entire quantity of chlorine water. In that case there would be a portion of the iodine and bromine lost. To prevent this, the mother liquor may first be treated by chlorine gas, and the operation finished by chlorine water.

This process does not take up much time and is very exact, as far as that may be said of the application of a quantitative analytical operation to a technical process. After extraction of the iodine, the alkaline salts remaining in solution can easily be obtained. The precipitated iodine must be resublimed.

INOFFENSIVE COLORS FOR TOYS.—M. Turpin.—The colors in question are chiefly lakes formed by eosin in combination with the earthy or metallic bases. These colors, mixed with chromate of zinc (?) in different proportions, yield bright shades, which may be advantageously substituted for red lead and chrome yellows.

## NEW COLORING MATTERS.

ACCORDING to a report presented to the Prize Jury of the Paris Exhibition, by P. Bonnet & Co., of La Plaine, near Geneva, the trade names Scarlet (écarlate) and Hortensia are applied to substitution derivatives of fluorescein into which bromine and hyponitric acid are simultaneously introduced. The scarlet serves for wool dyeing, while Hortensia can be equally well fixed upon cotton, silk, and wool. Pyrosin I is pure bi-iodo-fluorescein; pyrosin R is a mixture of bi and tetra-iodo-fluorescein. Both give a fine ponceau color, though tetra-iodo-fluorescein alone gives shades more approaching to violet. Rose Bengale, Phloxin, and Cyanosin are rose-colored dyes, which are bromo and iodo derivatives of fluorescein. Rose Bengale, which was discovered in 1876 by Nölting, and phloxin are not soluble in water; cyanosin is soluble in alcohol. Since 1877 the same firm offers the soda-salt of benzyl-fluorescein under the trade name of Chrysolin. It was discovered by their chemist, Reverdin, by the action of phthalic acid along with sulphuric acid upon a mixture of chlorbenzyl and resorcin. The coloring matter is soluble in water, and is easily fixed upon fibers with a fine yellow color. For fixing the resorcin colors upon cotton, the latter is worked in an alum-bath mixed with soda and in emulsive oils. Acetate of alumina is also a good mordant.—*Reimann's Färber Zeitung.*

## ELECTRIC LIGHTING.*

THE remarks made by me in the discussion of Mr. Shoolbred's paper on electric lighting, which he presented at the recent meeting of the British Association for the Advancement of Science, can be properly supplemented or extended by an inquiry into the relation of the expenditure of heat in the production of light by means of the burning of coal gas or by electrical force. These relations can be looked upon from several points of view. The first of these would be the purely theoretic one, and is based on the absolute heat which would be evolved under the condition of perfect combustion and absolute absorption of heat of coal gas in producing a given light as compared with the heat which represents the same light as derived from the power expended in producing it.

There is produced the light effect of one standard candle by the combustion of one-third of a cubic foot of coal gas each hour. That is, this result is that of the tests for quality of coal gas as established by law, but in practice of gas lighting with the usual imperfect burners not much above (if so much as) one-half the quantity of light is obtained. Accepting this quantity it can be asserted that the heat effect of a cubic foot of coal gas is 690 heat units (pounds of water heated one degree Fahrenheit), and that a candle power of light is represented by 230 units.

The Franklin Institute experiments did not give the light power claimed by most makers of dynamo-electric machines; they only gave as the result 280 candles of light as proceeding from one-horse power, while the general claim for at least two of the dynamo-electric machines is nearly five times this value (200 becs Carcel being claimed for the Lontin machine and lamps as given by one horse power. As each Carcel burner equals 9·6 candles of the English standard, it follows that this claim is for 1,920 candles per horse power). The Franklin Institute experiments also gave 31 to 38 per centum of the whole power as all that appeared in the resistance of the electric arc, which evolves the light, the remainder being expended in friction of machine and in the circuit, being dissipated as heat to the air probably.

Taking the value of 380 candles from one-horse power, we have, the force corresponding to one horse power equals 1,980,000 lbs. raised 1 ft. high per hour—a unit of heat=772 foot pounds . ·. one-horse power=2565 units of heat per hour, and 2565÷380 gives 6¾ units of heat per candle.

From which it appears that the theoretic expenditure of heat (or force) in producing gaslight is to that in producing electric light as 230 to 6¾, or as 34 to 1, while the theoretic expenditure of heat in producing gaslight is to that of the electric light in the arc alone as very nearly 100 to 1. All these are based on the Franklin Institute values; if the figures of M. Lontin are accepted the ratios become five times more favorable for electric lighting.

But the heat which can be evolved by the burning of coal gas does not represent the heat which appertains to the coal that would have produced the same coal gas. Each pound of gas coal which has undergone the process of destructive distillation will have produced very nearly, on the average, 4 cubic feet of illuminating gas, and there will remain, as a residue of the process of gasmaking, about 0·85 lb. of gas coke, and some 0·04 lb. or 0·05 lb. of gas tar, both of which substances are combustible. The quantity of coke, however, is reduced by the necessary use of coke in obtaining the heat for distillation until only 0·55 lb. to 0·60 lb. of unconsumed coke remains for each pound of coal originally charged in the retorts. Again, much of this coke is in the condition of dust or very fine breeze, so that practically only about 0·35 to 0·40 of gas coke is derived in merchantable or usable shape for each pound of coal originally treated; while the coal tar, although it possesses the constituents of a fuel, is not easily burned as such. Ordinary gas coal can be taken to have the value of 15,000 units of heat to each pound, and if it is supposed that from this quantity of heat there be deducted the heat value of, say, 0·6 lb. of coke, taken at 13,000 units to the pound=7,800 units, together with the heat value of 0·05 lb. of gas tar, taken at 20,000 units to the pound=1,000 units (total deduction 8,800), we have 6,200 units as the value of the fuel which yielded 4 cubic feet of gas. And, as before, taking each cubic foot of gas as evolving three candles of light, it follows that 517 units of heat will have been expended for each candle of light emitted, and this value should be taken as the expenditure of heat in lieu of the 230 units which the gas would produce after it is manufactured.

This statement, compared with the theoretic heat of electric lighting, as before estimated at 6¾ units per candle power, gives the heat in producing gaslight to that of producing electric light as 517 to 6¾, or as 76·6 to 1, while the theoretic expenditure of heat in producing gaslight is to that of the electric light in the arc itself as 230 to 1—with the multiplication of these ratios by five to follow, if M. Lontin's development of light per horse power is taken in place of that of the Franklin Institute.

Unfortunately for this statement, in a practical point of view, the production of the electric light by the dynamo-electric machines involves the employment of motive power in the form of the steam engine (I omit to consider the gas engine as the source of motive power, thinking that its adaptation to general use should precede a discussion of its economy in this special application). And in none of the utilizations of natural forces is quite so great waste of original force as in the combustion of fuel in the steam engine. The best of engines can scarcely be claimed to give out a horse power with less than 2 lb. of coal per hour, while the average of good engines of such size as would be at all available for power to run dynamo-electric machines of supposable smallness, cannot be taken to average less than 6 lbs. per horse power per hour. The former of these weights of coal represents 30,000 units of heat per hour to produce 2,563 units of effect, or only 8·55 per centum of the expended fuel, and the latter only 2·85 per centum (one thirty-fifth) of the same.

Taking this latter value as the practical one, the 6¾ units of heat per candle, which were the theoretic result of the Franklin Institute experiments, become 235 units of heat, in fact, needful to produce each candle. Our previous figures have given 230 units of heat as what would proceed from the best consumption of coal gas capable of producing one candle's light, and consequently the comparison of the heat practically demanded to produce electric light by the dynamo-electric machine actuated by the ordinary steam engine with the theoretic heat from coal gas is about 2 per centum against the electric system.

But the previous figures also give 517 units of heat as what is expended in the making of coal gas for each candle's light, and this value compared with that for the dynamo-electric light with its motive (steam) power is 2·2 times less favorable for the system of gas lighting. There is another way to look at the practical question. One pound of coal will produce 4 cubic feet of illuminating gas, each foot of which will have three candles' power; then omitting the other products of coal, 0·083 lb. of coal represents the fuel expended in giving the light of one candle in the same time by coal gaslighting. Following the previous assumption that 6 lb. of coal will under the boiler of a steam engine evolve one horse power, and taking the Franklin Institute value of 380 candles per horse power from the dynamo-electric machine, then 0·0158 lb. of coal represents the fuel in this case. This gives the practical relation of expenditure of coal (as fuel) in producing gaslight to that of the electric light under discussion=5·25 to 1. This last view of the case is practically not an unfair one, for while the coke and the coal tar are not absolutely waste products in process of gas making, they are by no means profitable ones in themselves, and it is questionable if they pay much more than the cost of handling and disposing of them, especially at places where coal for fuel is relatively cheap.

It must be noticed all through this paper that the assumption has been for the combustion of fuel by an ordinary steam engine and boiler at 6 lb. of coal per horse power, while a moderately good engine with boiler ought and will give a horse power for 3 lb. of fuel, and the best engines will only require under 2 lb. for the same result, so that all the practical ratios are two to three times less favorable toward the electric system than they might be.

It remains, however, that the most unfavorable statement of the relative expenditures of heat and fuel practically, of the electric system by the dynamo-electric machines and steam engine, as compared to that of coal gas for equal quantities of light, is, at present, 1 to 2·2; while in the processes there will have been burned as fuel 1 lb. of coal under a steam boiler, against 5¼ lbs. of coal treated in the retort for the manufacture of coal gas. Whether the cost of manipulation of the fires or the retorts, the wear and tear of machinery and engines employed in either processes, the interest upon the prime cost of apparatus, from the fireplaces to the points for illumination, may be in the same ratio as either the heat demanded or the coal used, is a question for further consideration and for future development.

Coal gaslighting would seem to have attained nearly to its ultimate development and improvement. Minor advantages of cost of manufacture, and possibly in the direction of quantity of light evolved by a given consumption, can be confidently looked for. The public have been and are habituated to all the defects of the system, and from the beginning to the end they are grave and essential. On the other hand the electric light has the promise of the greatest improvement in methods of production, in its adaptation to defined wants, and in its relative cost, so that the unfavorable view of it which I have here presented should not be taken, and it is far within the limits of probability that the best statement I have presented underrates its possibilities.

It may be proper to advert here to the low result in candle power for the electric light found by the Franklin Institute experiments. The power of light emitted by the candle or the gas burner usually tested by it is so small that the radiant light from the sides of a dark chamber may be neglected. The measurement of light is taken in all instances from the rays of a standard candle as emitted on the horizontal plane through the center of the flame. It was found first that this radiant light upon the walls of a dark box from the electric light was very great, and the means shown in the report of the committee (where it will be seen that only a pencil of light of not over a single degree of aperture was directed into the box or tube carrying the photometer) were found effectual to give a highly satisfactory comparison of the greater with the lesser source of light under investigation. Next it was found in the carbon experiments that there was an apparent unsteadiness of light of great amount emitted from the carbons. As the experiments proceeded it became evident that this unsteadiness was occasioned by the formation of an arc upon one side of the point (in place of a symmetrical brush, which traversed around the points as they wore away), emitting much the largest part of the light through a small arc of radiation in the horizontal plane, and presenting on one side of the points a brilliant reflection from them, and a corresponding obscuration on the opposite side. This difficulty was met and overcome by the adaptation of carbons of suitable sectional dimension for the current of electricity employed, until a uniform brush, emitting rays of very nearly equal value in all directions, was obtained. The Franklin Institute experiments consequently do not give the value of an apparent maximum of effect, but the mean effect from the electric lamps experimented with.

For practical data it may be well to state in conclusion that the result of 380 candles per horse power is that 90 lb. weight falling 1 ft. per minute represents the power demanded to afford a light of the best spermaceti candle by means of the dynamo-electric system. A man ascending a flight of steps at very moderate rate will have exerted a force equal to three candles. And the results claimed by many makers of dynamo-electric machines are four to five times as good as these.

The problem of electric lighting to-day is the production of small enough quantity of light with equal economy to that attained for large illuminating effects, and of the distribution into small sources of light of the great light

* A letter to *Engineering* by Robert Briggs, C.E., of Philadelphia, Pa.

capacity now obtained as a single point of emission. To these ends the intelligence of all electricians is now directed, and the attainment of some measure of success can be confidently anticipated.

## THE ELECTRIC LIGHT.

P. JABLOCHKOFF says, in a letter to the *Correspondance Scientifique*: "I have replied to the different questions generally put on the use of the electric light. Others have been since brought forward, one of which is: 'At what distance from the source of the electricity can a light be produced?' The answer is very simple. The distance may be as great as is desired, only a conductor of a proportionally greater diameter must be employed, so as not to augment the total resistance of the circuit. I must beg, at the same time, to be allowed a few words on an announcement which has appeared in the American papers, and has been reproduced in some European journals. Thus, in the *Times* of October 8, we read: 'The divisibility of the electric light remained still an unsolved problem: its solution was reserved for Mr. Edison.' But I have long ago effected the division of the electric light, as is proved by my communications to the Academy of Sciences (December 3, 1877), and to the Physical Society of France (February 1, 1878). This divisibility of the electric light has, moreover, been publicly shown, February 9, 1878, at a lecture delivered by Prof. Jamin in the great Amphitheater of the Sorbonne, and, what is more, the system has been at the Exhibition since May 1, 1878, open to all visitors to the Champ de Mars. In view of this fact I do not think it needless to mention the calculations included in the same announcement, not in order to discuss them, but to make known my opinion on such estimates. They are of two classes. The opponents of the electric light represent it as excessively costly. Partisans and promoters, on the contrary, put forward figures which cannot be called inexact, but which are merely theoretical, and consequently scarcely capable of being justified by practice, and liable to injure the cause of the light rather than to serve it. The electric light consumes hourly 5 grms. of pencil, composed simply of coke and plaster. A ton of the best coke costs 45 francs, and a kilo of plaster 0·50 centime. Taking these figures for the basis of our calculations, we find that the consumption of my electric light representing 100 gas-burners costs per hour $\frac{67}{1000}$ centime. Or an electric light equal to 10,000 gas-burners costs hourly 0·27 centime, while the corresponding amount of gas would occasion hourly an expense of 420 francs. No one can prove these figures inexact, yet I will not venture to put them forward as capable of realization in practice. Wherever the electric light has been introduced a notable saving has been effected. In the great shops of the Louvre, for instance, where this light has been in action for more than a year, the proprietors have found an economy of 30 per cent., and receive a better light. At the Théâtre du Châtelet the proprietor has dispensed with 30 francs' worth of gas every evening, and uses instead my system of electric light, which costs him only 14."

## THE PRESENT BUGBEAR OF FRENCH SAVANTS.

IT is certainly very curious to witness the remarkable state of irritability into which some of the savants and pseudo-savants of France have worked themselves over Mr. Edison and his discoveries; and it is, to say the least, highly amusing to observe the ill-concealed rage that these eminent individuals exhibit when anything new emanating from this American inventor is brought to their unwilling notice. Why is this? Is it because Mr. Edison's brilliant discoveries, which have electrified the world, succeed each other so rapidly that these profound scholars find it annoying to turn aside from the ancient beaten track along which they are plodding, in order to keep pace with them? Or is it because they esteem these matters of slight importance when compared with such themes as the "Gemmiparous and Fissiparous Reproduction of the Noctilucæ," the "Pressure of the Cephalo-rachidian Liquid," the "Fundamental Covariants of a Cubo-quadratic Binary System," or "Researches into the Sudorific Nerve-fibers of the Hind Paw of the Cat?"—these being the titles of a few of the deep subjects that have occupied the attention of the Académie this summer. Or, finally, we may ask, does not just the least bit of self-conceit, after all, dictate these remarkable mental manifestations? These questions may be properly left as a subject of psychological investigation. Meanwhile we regret to see some of the French scientific journals servilely playing "follow my leader" with some of these individuals. The *Correspondance Scientifique*, for instance, a very good little paper of its kind, and engaged in the very commendable work of popularizing science, celebrated, some time ago, its advent from the long clothes of lithography (in which it passed its infancy) to the more mature garb of typography, by a somewhat bitter espousal of the cause of Mr. Hughes, who was just at that time having an unfortunate dispute with Mr. Edison over the microphone. Now this was very reprehensible on the part of this journal, because making rash statements, unsupported by evidence, is not the correct way of diffusing scientific knowledge. Yet the editor forgot this; and, although at the time there was no proof that one contestant had greater claims than the other to the paternity of the microphone, he allowed his personal feelings to overcome his scientific caution in the production of an extremely one-sided editorial, which terminated with these significant lines:

"I cannot forget, on the other hand, the sympathetic and cordial reception that I received from him [Mr. Hughes] in London last month; the columns of the *Correspondance Scientifique* are, then, at his entire disposal!" To put this in other and equivalent words: "I am indebted to Mr. Hughes for what is dear to every Frenchman's heart – a good dinner; therefore Mr. Hughes was the inventor of the microphone; hurrah for Hughes!"

A little later, in the same paper, M. Venelle, in an article intended to be very ironical, devotes himself to the utter annihilation not only of the "megaphone," but of Mr. Edison as well. Having referred to the illustration of this instrument in the SCIENTIFIC AMERICAN of August 24th, and having made liberal extracts from our description of it, he exclaims, with all the enthusiasm that must have characterized Archimedes when he leaped from the bath tub, crying "Eureka:" "There! So, you see, Mr. Edison has not invented anything at all; his megaphone, to sum it up, is nothing but an imitation of all instruments designed to increase sounds produced at a distance. It is merely a case where we have, repeated, the proverb of the mountain and the mouse."

Now, since Mr. Edison has never claimed the megaphone as an *invention*, never paraded it before the public, nor ever regarded it in any other light than that of a medium for producing novel and interesting acoustic experiments, it becomes at once apparent that M. Venelle's overforced labors have themselves merely been crowned by the birth of a mouse —very ridiculous because of its insignificant size; and, now that this gentleman has acquitted himself of his momentous duty, we may properly bid him, in his own native language —*enfiler la Venelle!*

Again, it is but a few weeks ago that the world gazed in astonishment at the amazing exhibition which two juries of the French Exhibition made of themselves over the phonograph. The jury of the class of instruments of precision declared that this instrument could not be considered at all as one of precision, but merely a toy; consequently they sent it to the class of telegraphy to be rewarded. But the telegraphers replied that it was of no use whatever in telegraphy, and refused to examine it. The consequence was that the most wonderful invention in the whole Exhibition came near being unmentioned and unrewarded. Fortunately, and to their credit, the French people cried "For shame!" through their journals, and the phonograph received a medal.

But the most astonishing example of stupidity yet remains to be mentioned, in connection with the recent action of some of the members of the Académie des Sciences—and it would have been to the credit of the Académie had the details of the scene been suppressed. It may be remarked here that a large number of the great savants that compose this venerable institution show themselves bitterly opposed to the reception of all communications which are of a nature to in any way modify their ancient convictions. They seem to be particularly touchy on the subject of electricity, and are unable to hide their repugnance to the presentation of those various new discoveries which for some time past have been working such a profound revolution in human knowledge. A good specimen of this was given at the session of September 9th, when M. Du Moncel, after having captivated the attention of the intelligent audience present at the deliberations of the auguat body, stepped up to the desk of M. Bertrand, the perpetual secretary, and handed him some documents relating to the latest discoveries of Mr. Edison, "that astonishing inventor (says *Electricité*) who has more genius in himself alone than a whole scientific senate." Seizing, with ill-concealed impatience, the papers that his fellow member presented to him, the honorable secretary, without even taking the time to examine them any further than to rapidly run them over, declared formally that the *Comptes Rendus* could not accept them. "That precious collection," said he, "receives nothing but original documents, and those which, presented in the name of Edison, have been deflowered by publication in an American scientific journal, are not worthy of finding the least place in it." M. Du Moncel was replying sharply, and with a good deal of spirit, when he was interrupted by M. Bouillaud, who said he could not understand why it was that M. Du Moncel was for ever returning to the charge with new phenomena more marvelous than the preceding; he did not wish M. Du Moncel prevented from speaking, but he did wish that he might be restrained from repeating experiments to the Academy before he had tested them. To this unexpected thrust M. Du Moncel responded politely, and with a great deal of presence of mind, that he had never presented any experiment without having verified it himself, and that he had always repeated these experiments before the Academy when they were of such a nature that they could be performed in a room; but as to the telephone, two distant stations were requisite, and it was difficult to have these in the Academy's hall without using resistance coils. But M. Bouillaud could not let slip such a brilliant occasion to exhibit the state of his knowledge on the subject of acoustics. "He did not believe that there were telephones which transmit musical sounds, and others which transmit speech. He was willing to admit that there were *fagots* and *fagots*, but he would not have it that there were *telephones* and *telephones*." M. Du Moncel had taken the pains to explain the matter to him, when the president, M. Fizeau, asked the Academy to turn its attention to some other subject. It is proper to say that the illustrious Doctor Bouillaud was one of those clear-sighted academicians who chimed in with M. Sainte-Claire Deville, when the latter, but a few months ago, exclaimed at a full meeting of the Academy, that the phenomena of the phonograph were produced by a clever ventriloquist! The French papers do not state whether the Edison documents were subsequently accepted for the *Comptes Rendus*. If not, Mr. Edison is, after all, perhaps to be congratulated; for it is much better for either the present or future fame of Mr. Edison, or of any other inventor, that his discoveries should be brought to notice through a live scientific paper, than be filed away in the musty tomes of the *Comptes Rendus*, and be hidden for ever from sight on the dusty shelves of the Académie des Sciences.

## TUNGSTEN.

MANY attempts have been made to improve the qualities of iron and steel by the addition of small proportions of other metals. The most promising of all the experiments made in this direction turn on the introduction of certain proportions of tungsten or of chromium; and although these alloys can scarcely be said to have acquired as yet a firm footing in commerce, still results of indisputable value have been attained. In these important investigations particular merit belongs to the eminent metallurgist, M. E. W. L. Biermann, of Hanover, who has devoted a great amount of time and expense to a thorough study of tungsten and chrome, and whose labors are beginning to bear important results. He finds that either tungsten or chrome may be advantageously incorporated with iron in the Bessemer process. He melts 3,600 kilos of gray pig iron in a reverberatory furnace, and decarbonizes it in the converter in the usual manner. He then mixes with it from 200 to 300 kilos of a previously prepared alloy of tungsten, or of chromium, and iron. By this procedure he escapes all loss of tungsten or chromium by oxidation, and obtains a tungsten or chrome steel, in which either of these metals appears to be substituted for the carbon ordinarily present. This tungsten steel has been found to resist a greater breaking strain than the best "Huntsman's" steel. Puddled steel and iron and cast metal can also be decidedly improved in quality by additions of tungsten. These results are certainly in accord with those obtained by earlier experimenters. But this is easily explained if we consider that many so-called tungsten steels contained not a particle of tungsten, while the metals in others was accompanied by arsenic, sulphur, phosphorus, and other impurities noxious to the quality of iron and steel.

Tungsten further enters into the composition of other valuable alloys. Tungsten-bronze and an analogous compound of a rich violet color are prepared by the reduction of melting tungstate of sodium (or potassium) with a further addition of free tungstic acid. Minargent, an alloy much used in America, and said to combine the color and luster of silver with the hardness of steel, is composed of 100 parts copper, 70 nickel, 5 tungsten, and 1 part aluminum. We feel no hesitation in calling the attention of metallurgists to an element which holds out such great promises, nor can we forget that its utilization on the large scale would be a boon to the miners and mine owners of Cornwall, where it exists in abundance.

We have received from M. Biermann specimens of his interesting preparations, and must congratulate him on their quality.—*Chemical News.*

## THE NEW MAGNESIA PROCESS FOR BOILER FEED WATER.

WE extract the following from an article in the *Chemiker Zeitung*, by Mr. E. Bohlig, the inventor of the magnesia process:

My method of purifying water by magnesia is based on a series of reactions between the salts of lime and those of magnesia. So far we have believed the lime contained in water to exist in the shape of a carbonate, as it is obtained mostly in that form on evaporation. An examination of the properties of the salts of magnesia will, however, convince us that this is not the case. In case of the presence of magnesia besides the lime, either one existing as a sulphate, the other as a carbonate, we must necessarily accept the lime to be united to the sulphuric acid and the magnesia to the carbonic acid. If calcium monocarbonate is boiled with sulphate of magnesia, sulphate of calcium is formed and carbonate of magnesia.

Monocarbonate of magnesia is completely insoluble in water, basic carbonate a little more soluble. The latter possesses the property of decomposing calcium sulphate at ordinary temperature. In case the temperature is slightly elevated it gradually loses this capacity, and at an elevation of 100° C. it is without any effect whatever in this direction. Calcined magnesium oxide precipitates all the carbonic acid contained in a free state in water, thereby rendering the magnesia contained therein insoluble, as also other substances dissolved by the carbonic acid, while the calcium sulphate is decomposed by basic carbonate of magnesia.

From these facts will be seen how we must proceed to purify water by magnesia.

The author divides the waters generally used for feeding steam boilers into three groups, according to their behavior when treated by magnesia, as follows:

I. Waters containing carbonates of the alkaline earths and free carbonic acid, and no calcium sulphate. (Traces of the latter being of no account.)

II. Waters containing, besides carbonates of the alkaline earths and free carbonic acid, also a quantity of calcium sulphate, not exceeding the quantities of carbonate and free carbonic acid combined.

III. Waters in which the calcium sulphate predominates, and in which the carbonates are only of minor importance.

According to what has been stated above, it will be seen that all three classes can sufficiently be freed by magnesia of all the sulphates and carbonates, at ordinary temperature.

The following has been the experience of the author in actual practice:

Waters falling under I. and II. require treatment with magnesium only; after making a rough calculation, according to the chemical composition of the water, of the quantity of magnesia necessary for complete purification of the contents of the reservoir from which the boiler is fed, three times that quantity is weighed out and boiled with a small quantity of water in a separate boiler or kettle, steam being conducted through the mixture. The latter is then brought into the reservoir, which can now be filled with water, and the whole must then be well stirred for some time. This may, in larger reservoirs, be well done by forcing currents of steam through the water. This quantity will be sufficient for several refillings of the reservoir, the stirring being repeated every time. After that the water, when tested by oxalate of ammonia, will show lime again, and the same process must now be repeated, only two-thirds of the quantity of magnesia being taken. It will be found that this will be sufficient to purify just as much water as the first lot. After the reservoir has been refilled several times, a third lot, half as much as the second, is again added, till by degrees the smallest quantity necessary to purify the contents of the reservoir for a certain number of times is found.

As regards the waters falling under the third head, which we may call gypsum waters, we have to modify the process to some extent. The magnesia, instead of being simply boiled with water, must be partially converted into basic carbonate, which, as we have seen, decomposes the calcium sulphate. This is done by boiling it with water, while currents of furnace gases are forced in excess through the mixture. This must be done with all the charges. Hereby gypsum waters will immediately be freed of gypsum and magnesia at ordinary temperature; the magnesia must be, of course, well mixed with the water in the reservoir, which may be done by forcing currents of atmospheric air through the contents.

When waters of groups I. and II. are thus treated the monocarbonate is formed, which does not always completely settle down. Hence there would be some danger of the monocarbonate entering the boiler and causing a muddy precipitate. In waters of group I. we would, therefore, advise, besides the addition of magnesia, the addition of a quantity of slaked lime in form of milk every time the reservoir is filled. Hereby the greater part of the carbonic acid will be bound, while the magnesia present in the reservoir completes the process automatically. With waters of group II. this precaution is unnecessary, as the present sulphate of calcium paralyzes the effects of any monocarbonate of magnesia formed.

In starting the process one must not be discouraged if the results do not quite satisfy him during the first two weeks. It is frequently said that the magnesia does not settle well and does not precipitate all the lime. This may sometimes be the case when a sample of magnesia is slow in taking up water, as only in the hydrated state it is of any effect. I would, therefore, advise to keep the magnesia mixed with water, so as to have the process of hydration fairly started before the magnesia is placed in the reservoir. In that case nobody will ever have to complain.

Another point of great importance is the agitation of the contents of the reservoir, every time the latter has been filled, for at least a quarter of an hour. Filling the reservoir and omitting to agitate will, of course, not furnish a purified water.

ACCORDING to Clouet and Ritters, grape sugar is rarely free from arsenic, derived from the sulphuric acid used in its manufacture.

## OZONE AND THE ATMOSPHERE.

By ALBERT R. LEEDS, Ph.D.

[From proof sheets of the Annals of the New York Academy of Sciences.]

IN a paper entitled "Recent Progress in Sanitary Science"* I endeavored to give a short résumé of the labors of European physicists upon the estimation of atmospheric oxygen and ozone. I had been unable to find a published analysis of the atmosphere at any locality in the United States, all our knowledge upon the composition of the atmosphere being derived from foreign sources. Moreover, few systematic observations upon ozone had been prosecuted, or, if carried on, had rarely been published.

In making the oxygen estimations, Bunsen's methods were in most respects implicitly followed. The eudiometers employed were graduated by ourselves with great care. A gas room was fitted up, in which the thermometric readings rarely varied more than one half a degree during the periods of observation. The flasks employed to collect samples were of thin glass, 2½ c. m. in diam., 20 c. m. long, drawn out at one end into a tube about 15 c. m. in length. After cleansing and drying, a pellet of pure potassic hydrate was introduced and the tube sealed at a point about one-third from its extremity. When a sample was taken, the end of this tube was broken off with the aid of a file, the diameter of the tube near the flask narrowed down by heating in a lamp, the air in the interior completely changed by aspiration through a fine tube introduced until it nearly reached the bottom of the flask, which was then sealed with the flame. During the summer of 1876, numerous specimens of air were collected at Hoboken and vicinity, at the Centennial Exhibition, Philadelphia, and upon various mountain tops and in many valleys of the Adirondacks, New York State. The temperature, barometer, wind, etc., were noted at the same time, although these meteorological data are not of much importance, except as part of a connected and simultaneous series of observations, conducted with a view of establishing a chemical climatology of the United States. At present, what is done in this direction can be looked upon merely as the beginning of a study, which will hereafter yield results of value to the agriculturist, the medical practitioner, and the physicist. Suitable equipment of our observatories, so that they may yield not merely the meteorological, but also the requisite chemical data, is essential to advance in climatology. The following table contains some of the most interesting of the determinations heretofore made:

*Table of the percentage of oxygen* contained in the atmosphere at various localities in the United States, 1876.

| LOCALITY. | DATE. | PER CENT. |
|---|---|---|
| Stevens Institute of Technology..... | July 4th, 12. M. | 20.957 |
| " " " ..... | Aug. 2d, 1.20 P. M. | 20.957 |
| " " " ..... | " 11th, 1. P. M. | 20.821 |
| " " " ..... | " " (duplicate) | 20.843 |
| " " " ..... | " 29th, | 20.954 |
| " " " ..... | " 30th, 9.30 A. M. | 20.934 |
| " " " ..... | " 31st, 5.20 P. M. | 20.942 |
| " " " ..... | Sept. 1st, 10.30 A. M. | 20.952 |
| " " " ..... | " " (duplicate) | 20.957 |
| " " " ..... | " 7th, 10. A. M | 20.932 |
| " " " ..... | " " (duplicate) | 20.944 |
| Horticultural Hall, Centennial ..... | Aug. 15th, 3.40 P. M. | 20.964 |
| Machinery Hall, " ..... | " 21st, 5.15 P. M. | 20.937 |
| Main Building, " ..... | " 18th, 4. P. M. | 20.868 |
| Agricultural Hall, " ..... | " 22d, 3. P. M. | 20.857 |
| U. S. Building, " ..... | " 16th, 4. P. M. | 20.878 |
| Centennial Grounds, " ..... | " 15th, 6. P. M. | 20.962 |
| " " " ..... | " 18th, " " | 20.918 |
| Stevens Institute of Technology ..... | Sept. 26th, 10. A. M. | 20.915 |
| Keene Flats, Adirondacks..... | July 17th, | 21.029 |
| Mt. Marcy, Summit of..... | " 21st, 3. P. M. | 20.928 |
| " " " " ..... | " (duplicate) | 20.926 |

### ATMOSPHERIC OZONE.

In order to obtain some knowledge of the character of the results arrived at in testing for atmospheric ozone according to customary methods, I prepared a number of ozonoscopic papers, with pure materials, after the formula of Osann, and during the summers of the years 1876 and 1877, in the Adirondacks, and during the rest of this period, in Hoboken, made regular observations. At Hoboken the results were negative, an ozone reaction being obtained on rare occasions only, and then in the most feeble and undecided manner. On the contrary, in Keene Flats, N. Y., the days were few in which the ozonoscopes were unaltered; usually they were decidedly affected, and sometimes to a degree most striking. The point in the Keene Flats where the observations were conducted, was about 700 feet above sea level, the surrounding vegetation mostly deciduous, the population and dwellings, though scanty, not inconsiderable. Even more interesting were the results during the following summer, 1877, at a point near the upper end of Upper Saranac Lake. This was located at a much higher altitude than the foregoing, entirely isolated by miles of primitive forest from any other dwellings. The woods abounded in hemlocks, pines, larches, spruces, and were often redolent with odors of the balsam. Owing to a supposed virtue in these resinous smelling woods, large numbers of patients, especially those suffering from pulmonary diseases, are sent by the physicians of New York and other large cities, to this portion of the Adirondacks. Bearing in mind that the beneficial effects are supposed to be due entirely to the atmosphere—not to any mineral waters, or peculiarities of regimen, exercise, or occupation—one of these sanitariums, like that on St. Regis Lake, would afford an opportunity of testing some disputed points concerning the effects of a varying constitution of the atmosphere on different diseases.

Certainly the intelligent selection of an appropriate sanitarium is a duty frequently devolving upon the physician, but one which at the present time he can in many cases only imperfectly perform, from the lack of positive knowledge. Vague impressions or reports can never take the place of atmospheric analysis; they bear a similar relation to it with that which the ancient foretelling of the weather does to the present signal service reports. It is to be hoped that the time is not far distant when the Government may think it important to do as much for public hygiene as for commerce and agriculture.

Although in the light of subsequent experiments, little value I think can be attached to the following ozone observations, yet as illustrative of the variations in the amount of the so-called ozonic reaction, and of the apparent lack of connection between it and other meteorological phenomena, the accompanying table may be of interest:

REGISTER OF OZONE OBSERVATIONS,

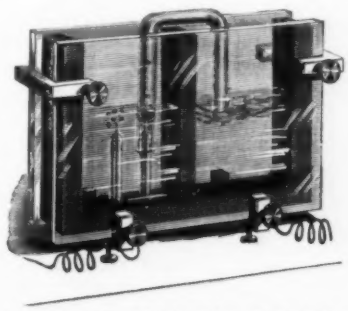
Made at Upper Saranac Lake, Northern New York, altitude 1,600 feet above the sea. Times of observation, 7 A. M. and 7 P. M. Season, summer of 1877. Scale of 10.

| DATE. | OZONE. | THERMOMETER. | BAROMETER. | WEATHER. WIND. | WEATHER. RAIN. | WEATHER. CLOUDS. | REMARKS. |
|---|---|---|---|---|---|---|---|
| July 17.. | 5 | 74° | 27 9 | S. | Heavy. | | Considerable lightning. |
| " 18.. | 2 | 70° | 28 | S. | | | |
| " 19.. | 2 | 71° | 27.675 | NE—SW | Much | | Great rain at night and light'ng. |
| " 20.. | | 70° | 28 85 | S.W. | .... | Cirrus. | Air very clear—rain at a distance. |
| | 2.5 | 73° | 27 9 | S.W. | .... | Cum. (1) | |
| " 21.. | 2 | 62° | 28 | S.W. | .... | Cum. (6) | |
| | 1 | 64° | 28 15 | S.W. | .... | Cum (1) | Very pleasant day. |
| " 22.. | 0 | 67° | 28 275 | S.W. | .... | Cum (1) | Great cumulus clouds. |
| | 0 | 72° | 53 275 | S W. | .... | Cum. (1) | Little air—not bracing |
| " 23.. | 1 | 68° | 28 85 | S.W. | .... | Nimb. (7) | " " |
| | 0 | 72° | 20 275 | S.W. | .... | Cum. 3) | |
| " 24.. | 1 | 66° | 28.3 | S. | .... | Cirrus (5) | |
| | 1 | | | | .... | Cum. (1) | |
| " 25.. | 0 | 68° | | | .... | Cum. (1) | |
| | 1 | 80° | .8 1 | | .... | Cum. (2) | |
| " 26.. | 1 | 71° | 28 | S.W. | .... | Stratus (3) | |
| | 3 | | 28 925 | S.W. | .... | " (1) | |
| " 27.. | 0 | 72° | 28 125 | S.W. | .... | " (5) | Heavy rain at night and lightning—in morning cool and refreshing. |
| " 28.. | 1 | 80° | 28.15 | S.W. | Rain. | Nimb.(10) | |
| | 5 | 72° | 28 1 | S.W. | .... | " (10) | |
| | 1 | | 28.05 | | Rain. | Nimb | |
| " 29.. | 1 | 72° | 28 | | Rain. | Cum. (2) | |
| | 1 | 76° | 27.925 | | Rain. | Nimb.(10) | |
| " 30.. | 3 | | | N. | .... | Cum. | |
| | 3 | 78° | 28.075 | N. | .... | Cum | Very bright. |
| " 31.. | 0 | 64° | 28.2 | S.W | .... | Clear (0) | Exhilarating. |
| | 6 | 72° | 28 25 | N. | .... | Clear (0) | |
| Aug. 1.. | 5 | 66° | 28.325 | Calm. | .... | Clear (0) | No air stirring. |
| | 4 | 75° | 28.275 | S. | .... | Clear (0) | Exhilarating. |
| " 2.. | 3 | 68° | 28 25 | S.W. | .... | Stratus (1) | |
| | 4.5 | 72° | 28 1 | S. | .... | " (3 | "Mackerel-sky." |
| " 3.. | 4.5 | 66° | 28.025 | S. | .... | " (10) | |
| | 2 | 72° | 27 925 | S.W. | .... | Cum (1) | Clear and bright. |
| " 4.. | 4 | 64° | 28.025 | N. | .... | Cum. (3) | Wind-storm at night. |
| | 2.3 | 66° | 28 | N. | .... | Cum. (5) | " in afternoon. |
| " 5.. | 2 | 62° | 27.95 | S. | .... | Cum. (1) | Opposing air-currents producing 5 storms |
| | 3 | 64° | 27.95 | S. | .... | Nimb.(10) | |
| " 6.. | 2 | 61° | 27.925 | N. | .... | Cum (1) | Brilliant atmosphere. |
| | 1.2 | 66° | 27.9 | N. | .... | Stratus (9) | Bright. |
| " 7.. | 7 | 63° | 27.8 | S. | .... | Nimb.(10) | Heavy rain at night. |
| | 6 | 72° | 27.8 | S. | .... | Stratus (7) | Shifting clouds. |
| " 8.. | 7 | 70° | 27.825 | Calm | .... | Clear (0) | Heavy rain and thunder during day. |
| | 7 | 70° | 27.825 | N.E. | Much. | Cum. (5) | |
| 9.. | 1 | 72° | 27.825 | S.W. | .... | Fog (10) | Haze (smoke). |
| | 3 | 74° | 27.775 | S.W. | .... | Cum (3) | Dull. |
| " 10.. | 3 | 72° | 27.8 | S.W. | Rain. | Cum. (1) | Haze. Little air. |
| | 1.2 | 65° | 27.35 | S.W | .... | Cum. (2) | |
| " 11.. | 1 | 65° | 27.975 | S.W. | .... | Strat's(10) | |
| | 1 | 67° | 28.075 | S.W. | .... | Nimb (4) | Thunder storms. |
| " 12.. | 0 | 68° | 28.05 | S. | .... | Clear (0) | Starlight night. |
| | 2 | 65° | 27.95 | S.W. | Much. | Nimb (10) | Opposing winds. |
| " 13.. | 1 | 68° | 27 95 | S W. | Much. | " (10) | |
| | 2 | 70° | 28 | N.E. | .... | Nimb. (9) | |
| " 14.. | 1 | | 27.925 | Calm | .... | Mist (5) | Heavy rain at night. |
| | 1 | 65° | 27.9 | W. | Rain. | Nimb (10) | |
| " 15.. | 1 | 67° | 27.925 | S.W. | Rain. | Cum.(10) | |
| | | 67° | 27 9 | N.E. | Rain. | Nimb (10) | |
| " 16.. | 5 | 64° | 27 875 | Cal m. | Rain. | Cum (10) | |
| | 1 | 66° | 27.85 | N.E. | Rain. | Nimb. (5) | |

### EXAMINATION OF METHODS IN OZONOMETRY.

On resuming laboratory work in autumn, an inquiry, which seemed essential before making any further observations upon atmospheric ozone, was the deportment of the various tests under precise and varied conditions. It was desirable to experiment upon the most convenient method of preparing ozone, upon the precautions requisite for obtaining it in as pure and concentrated a form as possible, and upon the methods of estimating its percentage in an atmosphere of ozonized air or oxygen.

*Preparation of Ozone by Electrolysis of Water containing Sulphuric Acid.*—Electrolysis was not found a convenient method of preparing ozone in considerable quantities. But it is so important to demonstrate the formation of ozone, according to the reaction which first attracted the attention of Schönbein, that the following novel experiment, which affords an impressive lecture illustration, is important.

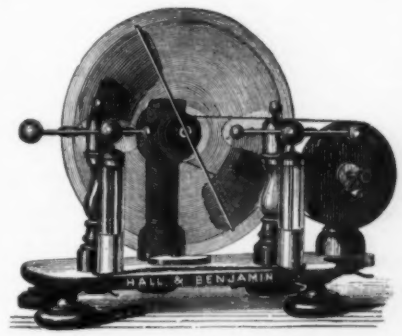


A glass tank is made, of thin sides of plate glass, and of less height and breadth than the diameter of a magic lantern condenser. These sides are held firmly against rubber walls of about 12 m. m. in thickness, cut out in such manner as to divide the tank into two cells One is partly filled with acidulated water,* the other with a 15 p. c. solution of potassium iodide.

The platinum electrodes from a battery of six Bunsen cells, rise from the bottom of the first compartment of the tank, covered, except at their ends, with glass tubes into which they have been previously sealed. A small bent glass delivery tube is slipped over the electro-positive pole, its end just dipping beneath the surface of the potassium iodide solution. Decomposition begins as soon as the mixture of oxygen and ozone has displaced the air previously in the delivery tube, and is made evident by the yellow color imparted by the liberated iodine. If, before projecting the image of the decomposition on the screen, a few drops of dilute starch have been added, the dark blue clouds, rolling away from the point of exit of the electrolytic ozone, are striking. A tincture of guaiacum, freshly prepared from the solid resin, shows the presence of ozone by a lighter blue coloration spreading across its surface in the tank; and an indigo solution is bleached. The last reaction is not so striking as the foregoing, since the bleaching is necessarily shown by a gradual, instead of an abrupt change of color.

*Preparation by Electricity.*—The methods followed to submit the oxygen, in as dry and cold and condensed a condition as possible, to the action of electricity, will be given in a subsequent paper. A large Holtz machine, manufactured by Ruhmkorff, did not answer satisfactorily as a source of frictional electricity. Examination showed that the surface of the vulcanite supports was coated with a saline incrustation, which proved to be sulphates, probably formed by oxidation of the sulphur contained in the vulcanite, under the influence of ozone generated in the working of the machine. This saline matter being hygroscopic, attracted sufficient moisture to destroy insulation.*

The insulation might have been restored by removing the coating; but in the remainder of the experiments I used the improved form of Holtz's machine, made by Messrs. Hall & Benjamin (see woodcut), and obtained excellent results. Various modifications of Siemens' apparatus, and the tube ozonizer of Prof. Wright,† were employed for ozonizing.




*Does the Electric Spark decompose Potassium Iodide?*—One of the most interesting points to be determined in connection with the ozone tests, was whether the electric spark alone would decompose potassium iodide, or whether the decomposition was not due to the ozone produced whenever the electric spark is taken in the ordinary manner. To settle this question it was essential to submit the tests to the

* Annals of the Lyceum of Natural History, New York, vol. xi., Nov., 1876.

* According to L. Hoffman, a maximum liberation of ozone is obtained from a mixture of 1 part sulphuric acid and 5 parts of water. (Pogg. 132, 607; Jahresb. der Chemie, 1867, 150.) The mixture should be kept as cold as possible.

* This difficulty had been previously noted by Prof. A. W. Wright, Am. J. Sci. [3], vol iv., p. 30.

† Amer. Jour. Sci., ib., p. 26.

spark taken either *in vacuo*, or in an atmosphere of some gas which, under the influence of the spark, would neither suffer decomposition nor enter into combination. The first method was attended with insurmountable difficulties, for which reason the second was adopted, hydrogen being the gas selected.

The hydrogen was purified by permanganate of potash solution, as proposed by the author, in an article entitled "Contributions to the Chemistry of Hydrogen." American Ass'n Adv. Science, Aug. 23d, 1876; American Chemist, Nov. 1876.* It was dried in the usual manner by sulphuric acid, and then passed over a length of 20 c. m. platinum sponge, which was kept heated at the middle. The farther end of this tube was filled with phosphoric anhydride, which gradually liquefied, from absorption of moisture. To make sure that all traces of oxygen had been removed, by entering into combination with hydrogen under the influence of the platinum sponge in the first tube, a platinum sponge guard tube was added, similar to the first, except that its anterior end, as well, was filled with phosphoric anhydride. In this guard tube, no change occurred. The tests were contained in an apparatus constructed as follows: A tube 25 c. m. long and 4 c. m. wide was drawn down at its ends, and fitted very tightly with rubber corks covered with tin foil. Through these corks glass tubes were passed, conveying platinum poles, the latter sealed to the tubes with only 5 m. m. of their free ends projecting. Two tubes were cemented on one side of the apparatus 6 c. m. from each end, and at the distance of 12 c. m., bent down at right angles. These tubes entered into small wash bottles containing sulphuric acid, one acting as a seal at the entrance, the other at the exit of the current of hydrogen.

In the first experiment, one specimen of each of the iodized papers was introduced into the apparatus. The hydrogen was then allowed to flow until all the air in the train of purifiers and driers had been displaced. Connection was made with the platinum sponge tubes, and a slow current was allowed to flow for 3 hours. The object of continuing the current so long a time was not so much with the view of displacing the air, as of thoroughly desiccating the papers. A stream of sparks was then passed between the poles, which were separated by an interval of 5 c. m.

The papers were pierced with numerous holes, but remained colorless. On opening the apparatus there was no smell of ozone, but an odor as of something burnt. The papers, on being moistened, developed faint blue stains at the points where pierced by sparks. The experiment was repeated with identical results. Either, then, it appeared, the sparks alone had decomposed potassium iodide, or ozone had been formed in the course of the experiment. That the hydrogen employed still contained oxygen, was negatived by the positive results obtained by the platinum sponge guard tubes, and not less so by the absence of any smell of ozone, this last being in fact one of the most delicate tests which we possess. But the burnt smell noticed each time the apparatus was opened, rendered it extremely probable that the paper, containing, as it does, the elements of water, had undergone some decomposition.

To eliminate these sources of error, a tube was partially filled with pure potassium iodide, and hung upon the electrodes. After desiccation in a current of hydrogen for many hours, sparks were passed through the iodide for a very long time. The magnificent color of the spark in hydrogen changed whenever the particles of potassium iodide were rendered incandescent. On testing the iodide afterwards, there was not the slightest indication of liberated iodine. From this it would appear that it is not the electric spark, but the ozone generated under its influence, which produces the chemical effects of decomposition in this and similar instances.

*Collection and Preservation of Ozone.*—A bottle, with mouth partially covered, may be filled with ozonized oxygen by *displacement*. It is noticeable that even when the entrance tube extends quite to the bottom of the bottle, the smell and iodo-starch reaction of ozone are obtained almost immediately, while quite an interval elapses before the air is so perfectly displaced that the issuing gas relights a spark at the orifice. Bottles so filled may be sealed with paraffine, and the contained ozone be preserved for hours. Great difficulty was encountered in making tight joints. It has been recommended to insert the ends of tubes to be joined, into a wider tube, and fill it with paraffine. But the adhesion of the paraffine is so slight, that such a joint easily comes apart. A better plan is to take a strip of cotton cloth about $1\frac{1}{2}$ in. wide, and of suitable length, wrap it tightly round the tubes to be joined, fasten with soft flour or copper wire, and then render it impervious by melted paraffine applied with a feather or brush. Tubes of very different diameters, and vessels of various dimensions, can be joined by suitably modifying this plan.

The action upon India rubber is very energetic, especially when under strain. This may be illustrated as follows: A piece of black rubber tubing is coiled tightly around a glass rod, and placed in a bottle through which a current of ozonized oxygen is allowed to flow, the gas entering at the bottom and escaping at the partially closed top. The black color disappears quickly, a dirty yellow following, and the surface becomes roughened. In a few minutes the edges are serrated, cracks open until the whole tube yields, and it falls into more or less ring-like fragments.

To determine more accurately the amount and kind of change produced in rubber, it was exposed to a slow current of ozonized oxygen (30 liters) for a number of hours. The gas, after passing over the rubber, was made to flow through a weighed sulphuric acid tube, then through a Liebig's bulb and sulphuric acid tube, then through another sulphuric acid tube acting as a guard, and finally through 3 Geissler bulbs, containing solutions of potassium iodide. The time and difficulty in making so many joints tight, by the aid of paraffine, were great. The results were as follows:

| | | |
|---|---|---|
| Porcelain boat + rubber after ozonizing | = | 7·2523 grains. |
| " " + " before " | = | 7·2415 " |
| Increase due to action of ozone | = | 0·0108 " |
| Sulphuric acid tube after ozonizing | = | 12·745 " |
| " " " before " | = | 12·739 " |
| Increase (probably water) | = | 0·006 " |
| Potash bulbs after ozonizing | = | 14·620 " |
| " " before " | = | 14·6094 " |
| Increase (probably carbonic acid) | = | 0·0106 " |

The first Geissler bulb was dark yellow, the second light yellow, the third colorless. The liberated iodine corresponded to 2·47 mgrm. ozone. The above experiment is far from being conclusive, and is given principally to show the need of investigation into the nature of the changes occurring in rubber and other organic bodies, under the action of ozone.

*Preparation by Chemical Methods.*—The most noteworthy result arrived at in an examination of these methods, was the discovery of a new method of generating ozone. When potassium permanganate and crystallized oxalic acid are pulverized together in a mortar, the heat developed is so considerable as to convert into steam much of the water formed during the course of reaction. If the salts are introduced into a test tube, and water added, the escape of gas at first is slow, but it rapidly increases with a corresponding elevation of temperature. Iodo-starch papers held at the mouth of the tube, show the presence of ozone in the escaping gases; so do those of guaiacum. Potassium iodide is little affected until the temperature is kept down by holding the test tube in cold water, when the amount of ozone liberated is so considerable that the papers turn brown at once. Here, then, we have two solid substances, which may be kept together for any length of time without change, but on the addition of water liberate ozone. The practical as well as the theoretical interest of this discovery is such that a careful study of this and similar reactions is now being made,

### CRITICAL EXAMINATION OF OZONOSCOPES.

*Potassium Iodide.*—As the potassium iodide manufactured in this country, and sold for chemically pure, has presumably been employed in the preparation of ozone tests by American observers, it was important to examine into its purity. The principal manufacturers are four in number, and their goods were examined, with the following results:

Analyses of C. P. Potassium Iodide manufactured in the United States:

| SAMPLE. | Reaction. | Carbonates. | Sulphates. | Chlorides. | Iodates. | Iodine. |
|---|---|---|---|---|---|---|
| I. | Alkaline | Absent | Absent | Absent | Absent | Absent |
| II. | " | Present | Present | " | " | Present |
| III. | " | Absent | Absent | " | " | Absent |
| IV. | Neutral | " | " | Present | " | " |

It will be seen from this table that of the goods purchased at the time the analyses were made, those of but one manufacturer were free from foreign salts and had a neutral reaction. And as nothing is easier than the introduction of minute amounts of impurities into chemicals manufactured on a large scale, the necessity of analyzing each sample of potassium iodide employed in the making of ozonoscopes is evident.

In order that no unnecessary element of uncertainty, however, should be introduced into the comparison of the various ozone tests employed in this investigation, the potassium iodide was especially made for the purpose. The following method was found convenient, and yielded excellent results:

Of iodine, 36 grms. were introduced into a flat-bottomed half-liter flask, with 250 c.c. water, and then 12 grms. of clean pianoforte wire were added in successive portions. The action at first was slow, but increased with the liberation of heat due to chemical combination, and at the close was accelerated by heating on a water bath until all brown color had disappeared. To the filtrate, which was of a greenish color, 12 grms. of iodine were added. Potassium carbonate, prepared by ignition of potassium bitartrate, was added to decided alkaline reaction, and the flask heated on a water bath until the precipitate separated in the form of ferrosoferric hydrate. This precipitate, after filtering, was evaporated to dryness and washed out carefully to obtain the last portion of potassium iodide. The filtrates were evaporated, and two portions of crystals, amounting to 13·5 grms. and 11 grms. of pure potassium iodide obtained from them. The mother-liquor was then evaporated to dryness, alcohol of 85 per cent. added to dissolve out the iodide and get rid of potassium carbonate; the potassium iodide crystallized from the alcoholic solution and washed with absolute alcohol, yielding 29·5 grms. of the salt. The total yield was 54 grms. instead of 62, the theoretical amount.

*Starch.*—In order not to spend time unnecessarily in the examination of starches from various sources, a skillful pharmaceutist furnished me with arrowroot starch, which he had assured himself by microscopic examination contained no substances of organic origin other than the starch granules. This was washed with large excess of cold distilled water until the filtrates afforded no trace of saline matters, and then dried at the temperature of the air.

*Paper.*—A great variety of papers was examined, and all rejected for one reason or another except the best Swedish filter paper. This appeared to have no action on the tests, except possibly upon the thallium and the Moffat. The former, after keeping for some time, was minutely spotted with thallic oxide, and the latter turned brown on the edges. But it is probable that, in the latter case at least, the alteration of the ozonoscope was due to other causes than the paper. The paper might have been treated with dilute acid, and then repeatedly washed with distilled water, in order to remove all the impurities soluble in these menstrua; but this was not done for fear that the paper might be made too fragile to stand much subsequent handling. But fine cotton cloth treated in this manner might answer for certain of the tests better than paper.

*Classification of Ozonoscopes.*—The most important ozonoscopes hitherto in use may be conveniently grouped into five classes:

I. Those depending on the decomposition of a metallic iodide, the liberated iodine indicating the reaction. Under this head the substance almost exclusively used is iodide of potassium. An examination of the tables given below will show that it is the most sensitive of all the ozonoscopes examined. Unfortunately the action of ozone does not stop with oxidation of the potassium, but extends to the iodine, so that a paper once brown from free iodine may become quite colorless again from the formation of potassium iodate. It is proposed to examine other haloid compounds, especially the iodides of the heavy metals.

II. Class No. I., with starch added as an indicator. Very many tests included in this class have been proposed. They differ chiefly in the relative proportions of potassium iodide and starch. With some the comparison is made when dry, in others, after moistening. Or the paper may contain potassium iodide only, the iodide of starch being formed subsequently by moistening the papers, after exposure, with starch solution. We have added to this list one new test, containing iodide of cadmium (as representative of the iodides of the heavy metals) and starch. It develops the characteristic blue color of iodide of starch very strongly and persistently on moistening, but is less sensitive than some of the other tests.

III. Those depending upon the alkaline reaction resulting from conversion of the electro-positive element into the form of oxide, litmus or some similar coloring matter being added as indicator. It will be seen from experiments detailed below that there are other bodies sometimes present in the atmosphere which decompose potassium iodide as well as ozone. But if this decomposition is attended with formation of caustic potash only when ozone is the decomposing agent, the litmus paper will be turned blue only in case of the presence of ozone. This was the ground taken by Houzeau, who proposed and has strenuously advocated tests of this character. He admits, however, that hydrogen peroxide will likewise develop an alkaline reaction. The tables, above referred to, exhibit a similar result.

The best method of preparing these tests is to saturate papers with litmus solution containing about 1 centigramme of litmus in 1 c.c. The litmus must be brought with great care to that shade of wine red at which it is most sensitive. After drying, some of these papers are impregnated with a 1 per cent. solution of potassium iodide and again dried. Papers of both kinds, the plain and iodized litmus, are cut into slips and exposed in pairs. It is expedient to subject these tests to the action of artificially prepared ozone to see that they are really sensitive. Great differences were found in this manner between tests not apparently differing much in color. Even the best did not appear so sensitive as some of those in the first and second classes. (See tables.)

Two new tests were added to this class—the alizarine and phenolphthalein potassium iodide tests—distinguished by the use of alizarine or phenolphthalein in place of litmus. The alizarine was prepared by dissolving the crystals sublimed from commercial alizarine in 80 per cent. alcohol.

Papers impregnated with this solution were dried, moistened with a 1 per cent. potassium iodide solution, and dried again. The latter were exposed in strips, along with non-iodized alizarine papers. The phenolphthalein was made by heating 3·3 grms. sublimed phthalic anhydride with 6·6 grms. phenol and 1·5 grms. sulphuric acid at 120°—130° C., for three hours, thoroughly washing the brown resin obtained, which amounted to about 3 grms.,* and dissolving in alcohol.

The phenolphthalein potassium iodide tests were prepared in a manner similar to those of alizarine. It was found, however, that neither of these tests, especially the phenolphthalein, was as sensitive as that made with properly-prepared litmus, and their use, after some trials, was therefore abandoned.

IV. Those depending upon the oxidation of a metal or metallic compound, with the development of a corresponding change of color.

The most important ozonoscopes in this class which have previously been studied are silver, thallous hydrate, manganous sulphate, and plumbic sulphide. Silver leaf immersed in an atmosphere containing a sufficient percentage of ozone is very slowly affected, if at all, except in the presence of moisture. Under these circumstances its surface is energetically oxidized, with the formation of magnificent yellow, blue, and other films, passing into black at those points at which the formation of argentic oxide has reached a maximum.

Unfortunately, silver is not sufficiently sensitive to ozone. In a vessel containing in every liter of oxygen 1 mgrm. of ozone, the potassium iodide, the iodo-starch tests, the thallous oxide, Houzeau's, and some other tests were affected, before a notable change had occurred upon a moistened silver surface.† It is stated by Houzeau that when a liter of oxygen containing about 1 centigramme of ozone was passed over silver, blackening took place, but when the same amount of ozone was diluted with 50 liters of oxygen, the silver was unaffected.‡ Even the latter mixture contains a far larger amount of ozone than is ordinarily present in the atmosphere, if we accept the determinations of Pless and Pierre,§ who found, by titration of the iodine set free on the surface of potassium iodide paper, that 255 liters of air contained but 0·02 mgrm. ozone. Zenger found in 100 liters of air from 0·002 to 0·01 mgrm. ozone.‖

For the present, at least, silver is inapplicable as an atmospheric ozonoscope, not from want of reliability, but from lack of sensitiveness; and the desideratum is to find some ozonoscope which will be similar to silver in its reactions towards the compounds of the atmosphere, and at the same time of adequate sensibility.

The next most important reagent of this class is Thallous Hydrate.¶ Small bars of metallic thallium were dissolved in diluted sulphuric acid, the reaction being hastened by the introduction of strips of platinum foil, and thallous sulphate crystallized out in brilliant prismatic needles. A solution of this salt was exactly neutralized with baryta, the filtrate from the barytic sulphate containing 10 p. c. of thallous hydrate. Strips of filtering paper, immersed in this filtrate, were dried over caustic potash under a bell-jar, so as to prevent them, as for as possible, from absorbing carbonic anhydride from the air.

When the ozonoscopes are compared dry, thallous hydrate occupies a very high position, sometimes the fourth or third place, but usually the second position. After moistening, the papers of the first three classes exhibit a more striking appearance than the thallium peroxide. This result differs from that obtained by Huizinga, who thought that the thallous hydrate was more sensitive than the iodo-starch tests, when the papers were *freshly* prepared and the solution sufficiently concentrated.**

On examining into the behavior of thallous hydrate, when exposed to the disturbing influences of the other bodies which may be present in the atmosphere, we found that it was unaffected by nitrous acid, if we except one trial in which the paper turned yellow. This was apparently due to some other cause than the formation of peroxide, which is of a brown color. This confirms the result previously arrived at by Böttger.††

In an atmosphere containing hydrogen peroxide, the thallous hydrate remained white, or, if immersed, after having been turned brown by ozone, was bleached. Carbonic anhydride is rapidly absorbed by thallous hydrate, carbonate being formed, which is not decomposed with formation of

* Later by Shobig, Jour. pr. Chem., II., xiv. 289; Oct., 1876.

* See Bayer, Ber. der Deutsch. Chem. Gesell., 1871, p. 658.

† See also Fremy, Compt. Rend., 61, 939.

‡ Comptes Rendus, Dec. 18, 1865.

§ Jahresb. der Chemie, 1857, 79.

‖ Zenger, Wien. Akad. Ber., 24, 78.

¶ Böttger, J. pr. Chem., 95, 311.

** Huizinga, Journal für praktische Chemie cl., 321.

†† Böttger, Journal pr. Chemie, 95, 311.

peroxide in presence of ozone. Thallous hydrate is therefore not applicable to the detection of ozone in the atmosphere, though in the laboratory, to detect ozone in the presence of nitric acid, it is of great service.*

Manganous sulphate is altogether inapplicable as an atmospheric ozonoscope, whether dry or moist; in the former condition it was scarcely affected at all, in the latter it occupied one of the lowest places in the scale. That there might be no error, from want of care in the preparation of the salt, the recrystallized sulphate was precipitated from its solution in alcohol, and used in making the tests. Thinking that the manganous oxide might be more easily converted into peroxide, if it were in combination with a feeble acid like acetic, some manganous acetate was prepared from the former salt by conversion into carbonate and then into acetate. Tests prepared with this salt did not appear more sensitive than those with manganous sulphate. They had the farther disadvantage of being powerfully affected in a dilute atmosphere of nitrous acid, turning dirty brown, while the sulphate was little changed. They likewise became light brown in an atmosphere containing a trace of hydrogen peroxide. The manganous sulphate ozonoscopes contained 10 mgrms. of the salt in each square centimeter of surface. Of the manganous acetate papers, some were dipped in a concentrated, others in a more dilute solution, but the results obtained with each were identical.

Similar remarks apply to the plumbic sulphide papers, which were so prepared that each square centimeter of surface contained about 10 mgrms. of the sulphide. They were not sensitive. Moreover, in an atmosphere of hydrogen peroxide or nitrous acid, they were bleached.

V. Those depending upon the oxidation of organic bodies, with the development of a characteristic change of color.

The only one of these substances particularly studied was the resin of Guaiacum. It appeared essential to use this resin in the original masses, for if that which had been pulverized was used, even if it had not been exposed to light, the tincture made from it appeared deficient in sensitiveness. A tincture containing 8 per cent. of the resin was prepared with 90 per cent. alcohol. The papers so prepared had a slight yellow tinge. They were moderately sensitive, acquiring speedily when dry a faint blue color, and when moistened occupying a position midway between the ozonoscopes most sensitive and those least so to the influence of ozone. They were rapidly turned greenish-blue by nitrous acid, and bluish-green by hydrogen peroxide. For these reasons, and on account of their deficient sensibility, they are objectionable as atmospheric ozonoscopes.†

*Examination of Ozonoscopes under known conditions.*—Having prepared pure materials, the following ozonoscopes were made, care being exercised to render them as nearly similar and uniform as the nature of the tests would permit. They were preserved in tightly-stoppered bottles, in the dark, and entirely removed from the laboratory odors. The potassium iodide papers were made with a solution containing 15 grms. of the salt. The proportion of iodide potassium and starch in the iodo starch papers is that recommended by the observers whose names they bear. The amount of water is the same in all, in order that the papers compared may be as nearly similar as possible.

| NAME OF OZONOSCOPE. | POTASSIUM IODIDE. | STARCH. | WATER. |
|---|---|---|---|
| Polli's | 2· grms. | 1 grm. | 60 c. c. |
| Moffat's | 0·4 " | 1 " | " |
| Lowe's (with 0·08 grm. cal. carb. | 0·2 " | 1 " | " |
| Schonbein's | 0·1 " | 1·1 " | " |
| Osann's | 0·1 " | 1 " | " |
| Cadmium iodide 1 grm. | | 1 " | " |

The preparation of the other tests is given elsewhere. The tests prepared with great excess of potassium iodide, as recommended by Dr. Polli, were not employed, since they turned brown while drying. The sensitiveness of these tests, as will be seen from the tables, increases, as a rule, with the percentage of potassium iodide. Those of Lowe, which occupy an intermediate position, and are not liable to change on drying, are perhaps to be preferred. Calcium carbonate was added in accordance with the recommendation of Mr. Lowe, in order to secure greater uniformity of action and prevent souring, but we were unable to perceive that the addition was of practical value.‡

The tests were separately suspended in a capacious bell-jar, through which a current of ozonized oxygen, containing 1 mgrm. ozone in the liter, was caused to flow very slowly. No attempt was made to screen them from diffused light. In the first place, they were simultaneously exposed, while dry, for certain intervals. The effects were noted, and expressed by numbers, the ozonoscope which had experienced the most striking change being placed first. They were then moistened, and the results indicated in like manner. Finally, in this moistened condition, they were allowed to remain in the vessel, and their changes noted at the expiration of times indicated in the tables. The effect upon silver is not given, because of its want of sensitiveness, and its inapplicability as an atmospheric ozonoscope.

* See Lamy, Bull. Soc. Chim. [2], 11, 210; March, 1869.

† It is probable that the influence of light, as well, would be unfavorable to the employment of organic matters as ozonoscopes.

‡ E. T. Lowe, Proc. Royal Soc [12], p. 518.

SECOND SERIES. THIRD SERIES

| OZONOSCOPES. | DRY | | MOISTENED | DRY | MOISTENED |
|---|---|---|---|---|---|
| | 5 MINUTES. | 15 MINUTES. | AT ONCE. | 15 MINUTES. | AT ONCE. |
| K I | Yellow | Brown (1) | (1) | Dark brown (1) | (1) |
| Cadmium | ..... | Yellow (5) | (6) | ..... (9) | (9) |
| Moffat | tr. | " (4) | (2) | Grey (5) | (2) |
| Lowe | ..... | ..... (6) | (3) | Greenish (7) | (3) |
| Osann | Lilac | Violet (2) | (5) | Lilac (6) | (4) |
| Schönbein | ..... | ..... " | (8) | Faint lilac (8) | (5) |
| Houzeau | ..... | ..... " | ... | Blue (2) | (6) |
| Alizarine | ..... | ..... " | (7) | Red (3) | (7) |
| Thallium | tr. | Brown (3) | (4) | Brown (4) | (8) |
| Manganese | ..... | ..... " | ... | ..... | ... |
| Lead Sulphide | ..... | ..... " | ... | ..... | ... |
| Guaiacum | (not tried) | ..... " | ... | (not tried) | ... |

FOURTH SERIES.

| OZONOSCOPES. | DRY | MOISTENED | |
|---|---|---|---|
| | 10 MINUTES. | AT ONCE. | HALF AN HOUR. |
| K I | Yellow (1) | Yellowish red (1) | Same as before (1) |
| Cadmium | ..... | Blue (6) | Darker blue (5) |
| Moffat | tr. (4) | Bark blue (2) | Same (2) |
| Lowe | tr. (5) | Blue (3) | Same (4) |
| Osann (not tried) | ..... | ..... | ..... |
| Schönbein | ..... | tr. (7) | Blue (3) |
| Houzeau (not tried) | ..... | ..... | ..... |
| Alizarine | Redn'd (3) | Same as before (5) | Same (8) |
| Thallium | Brown (2) | " " " (4) | Same (6) |
| Manganese | ..... | ..... | ..... |
| Lead Sulphide | ..... | ..... | ..... |
| Guaiacum | ..... | ..... | ..... Blue (7) |

It will be noted that potassium iodide is the most sensitive test, changing rapidly while dry, using this term to apply to papers having only such hygroscopic moisture as had been attracted from the atmosphere. The thallium papers are also very sensitive. But when exposed for some time, in common with the other ozonoscopes, and then moistened, they fall behind the iodo-starch papers, which occupy an intermediate position between them and the potassium iodide test. The iodo-starch papers arrange themselves in an order corresponding to the amount of potassium iodide they contain, except the cadmium iodo-starch paper, which, unlike the other ozonoscopes of this class, does not, on moistening, after long exposure, turn brown, but remains of a persistent blue. In some trials it fell below the thallium, alizarine, and Houzeau tests in sensitiveness. It is important to note that the alizarine and Houzeau tests, whatever may be their other merits, are less susceptible than the potassium iodide and iodo-starch tests; and the manganese and lead sulphide are evidently inapplicable as atmospheric ozonoscopes.

*Influence upon Ozonoscopes of Constituents of the Atmosphere other than Ozone.*—The air in the bell-jar, in which the tests affected as above were suspended, contained nitrous fumes in quantity just sufficient to give a recognizable color; in the following experiment the amount was extremely small, and no fumes were apparent:

OZONOSCOPES (AFTER OZONIZING) WITH SULPHUROUS ANHYDRIDE (first table, next page).

(1). Potassium iodide and all the iodo-starch papers bleached.

(2). Thallium, after having been ozonized to a dark-brown, is bleached.

(3). Manganese sulphate and acetate remain intensely brown.

(4). Guaiacum, alizarine, and Houzeau test, little affected.

Carbonic anhydride had no effect on the ozonoscopes, either before or after ozonizing.

The hydrogen peroxide in first series table 2. next page, was made from hydrated peroxide of barium, by decomposing with hydrochloric acid. The papers were suspended for about 15 hours over a solution containing 0·0044 grm. of the peroxide. Since the solution, prepared in this way, contained a little acid which had not been entirely removed, and this acid, by reacting with the peroxide, might liberate chlorine,—a second series of trials was instituted. In this the solution had been prepared by decomposing with carbonic acid, and contained 0·5 per cent. of the peroxide. The ozonoscopes were exposed during a like interval.

OZONOSCOPES WITH NITROUS FUMES (VISIBLE.)

| OZONOSCOPES. | DRY. | WHEN MOISTENED BECAME. |
|---|---|---|
| K I | Brown (1) | Bleached (1) |
| Cadmium | Lower end lilac, upper brown (2) | Bluish-black (2) |
| Moffat | Brown (5) | Dark blue (3) |
| Lowe | Light brown (6) | " " (4) |
| Osann | Lilac (7) | Light blue (6) |
| Schonbein | Light brown (9) | Dark blue (5) |
| Houzeau | Red (8) | Red (8) |
| Alizarine (with K I) | Brown (10) | Unaltered |
| " (no " " ) | Yellow | |
| Thallium | Doubtful | |
| Manganese Acetate | Unaltered (11) | Brown (7) |
| " Sulphate | " | Unaltered |
| Lead Sulphide | Bleached white (4) | " |
| Guaiacum | Dark blue (3) | " |

In a third series, the papers being exposed for 48 hours during day and night, over a solution containing 0·2 per cent. hydrogen peroxide, Moffat's turned to a brown color, Osann's became brownish-blue, guaiacum a beautiful light blue, alizarine reddened, Houzeau's test apparently changed somewhat in the direction of blue and afterward was partly bleached, cadmium test became dark-blue, potassium iodide quite white and damp, lead sulphide bleached to gray, silver was not affected. It is probable that the potassium iodide was decomposed, but became colorless again by conversion into iodate. This supposition was strengthened by the damp condition of the paper. The thallium test remained white, thallium peroxide undergoing reduction in contact with hydrogen peroxide, water and oxygen being liberated.

OZONOSCOPES WITH NITROUS FUMES (INVISIBLE).

| OZONOSCOPES. | DRY. | | MOISTENED. |
|---|---|---|---|
| | 20 MINUTES | ONE HOUR | TURNED AFTER 12 HOURS |
| K I | Yellow (1) | | Brown |
| Cadmium | Unaltered | Unaltered | Dark blue |
| Moffat | Light brown (4) | | 1, Dark brown |
| Lowe | Unaltered | Light brown (6) | 2, Brown |
| Osann | Light lilac (3) | | (4) " |
| Schönbein | Unaltered | Faint lilac (7) | (3) " |
| Houzeau | Reddish (5) | | Little changed |
| Alizarine (with K I) | Unaltered | | Reddened |
| " (no K I) | " | | " |
| Thallium | Light brown | | Brown |
| Manganese Acetate | Unaltered | | |
| " Sulphate | " | | |
| Lead Sulphide | " | Slightly bleached (8) | More bleached |
| Guaiacum | Greenish (2) | | Greenish-blue |

FIRST SERIES OF COMPARISONS.

| OZONOSCOPES. | DRY | MOISTENED | | |
|---|---|---|---|---|
| | HALF AN HOUR. | AT ONCE. | ONE HOUR. | TWO HOURS. |
| K I | Dark Yellow | Brown | Brown | (1) Very brown |
| Cadmium | ..... | Lilac | Strong blue | (3) Dark blue |
| Moffat | Violet | Blue | Dark blue | (2) Black |
| Lowe | ..... | Faint blue | Dark blue | (4) Blackish blue |
| Osann | (not tried) | ..... | | ..... |
| Schonbein | " | ..... | | ..... |
| Houzeau | " | ..... | | ..... |
| Alizarine | " | ..... | | ..... |
| Thallium | " | ..... | | ..... |
| Manganese | ..... | ..... | | (6) Brownish |
| Lead Sulphide | ..... | ..... | | ..... |
| Guaiacum | | Light blue | | (5) blue |

*Action of Ozone upon the Coloring Matter of Flowers.*—In connection with the use of organic coloring matters as ozonoscopes, experiments were made as to the action of ozone upon flowers. It is well known that indigo solution, poured into a bottle filled with ozone, is instantly bleached. In this case the colorless modification of indigo is formed. But attempts hitherto made to destroy the coloring matters of plants by ozone, have yielded in our hands negative results. These results are striking as compared with those obtained by a reducing agent like sulphurous acid, or with chlorine.

## OZONOSCOPES WITH SULPHUROUS ANHYDRIDE.

| OZONOSCOPES. | DRY | MOISTENED | SAME AFTER 12 HOURS |
|---|---|---|---|
| Houzeau | Red | Turned brown? | Became white |
| Alizarine | Yellow red | | A little b eached? |
| Manganese Acetate | | | |
| Lead Sulphide | | | |
| The rest unaffected | | | |

## OZONOSCOPES WITH HYDROGEN PEROXIDE.

| OZONOSCOPES. | FIRST SERIES. | SECOND SERIES. |
|---|---|---|
| K I | Light yellow (7) | Yellow (10) |
| Cadmium | Faint lilac (8) | Intense blue (6) |
| Moffat | Light brown (2) | Very dark brown (1) |
| Lowe | " " (3) | Dark brown (2) |
| Osann | ? (9) | Brown to blue (3) |
| Schönbein | Faint brown (4) | " " (4) |
| Alizarine | Red (6) | Reddened (8) |
| Houzeau | | Bluish (9) |
| Thallium | ? | Unchanged |
| Manganese | Light brown (5) | (Not tried) |
| Lead Sulphide | Somewhat bleached (10) | Bleached to gray (7) |
| Guaiacum | Blue (fine color) (1) | Beautiful b ue (5) |

A light red rose was exposed for three hours to a current of 3½ liters of ozonized oxygen, containing a little more than 1 mgrm. ozone per liter. No effect was discernible on either leaves or flower. In sulphurous acid, it was bleached in the course of a few moments, though the chlorophyl of the leaves was unaffected. Returned to the ozone, the blanched petals reddened, showing that the sulphurous acid with which they were impregnated had been ozonized. The same effect was produced by dilute sulphuric acid.

An abutilon, a yellow and a blue pansy, cineraria, red geranium, fuchsia, hyacinth, pink, violet, and heliotrope, were exposed for 18 hours, in a quart bottle filled with ozone. On opening the bottle no smell, except the perfume of the flowers, was apparent, and none of the flowers had changed except the violet and heliotrope. These had turned slightly brown, due probably to natural wilting. Other specimens of the same flowers were placed in an atmosphere containing sulphurous acid. The heliotrope began to change immediately, and in ten minutes its colors had entirely disappeared. The hyacinth followed, and in the same length of time, only streaks of red remained. The bouvardia was nearly white; the fuchsia, japonica, geranium, and cineraria were somewhat bleached; the yellow pansy not noticeably affected. At the end of 3½ hours, the darker portion of the fuchsia was nearly bleached, the geranium had become pink, the blue pansy was of a yellow color somewhat darker than the yellow pansy, the abutilon still unchanged. Flowers of *Salvia splendens*, *Camellia Japonica* (red), *Strelitzia regina*, *Abutilon venosum*, *Abutilon insigne*, *Inga pulcherrima*, *Ixia*, *Cineraria*, *Nasturtium*, *Azalea Indica*, and *Bouvardia* were exposed for 36 hours to ozonized oxygen, most of the time to a slow continuous current. A few light spots appeared on the azalea and nasturtium, and there was a slight discoloration of the camellia. Similar specimens, left for 3 hours in an atmosphere containing sulphurous acid, changed greatly: the camellia became lighter in spots and finally pink throughout, the azalea turned yellow and finally white, the *Abutilon venosum* saffron-yellow, the change beginning at the outer edge of the flower, the cineraria was somewhat lighter in color, the *Salvia splendens* white in spots, other portions red.

The *Ixia* had become white, the long ends of the mimosa (*Inga*) were also bleached, the reddish markings of the nasturtium had quite disappeared. The flowers of the *Bouvardia* were bleached at their outer edge; in the *Strelitzia*, neither flower nor leaf was affected. The same is true of the leaves of all the specimens.

After 18 hours more of exposure the yellow portion of the *Strelitzia* was not affected, but the blue had become quite white; the mimosa was a faint pink, the nasturtium a deep yellow throughout, and the *Salvia* bleached entirely. Even after this length of time, the chlorophyl of the leaves had undergone no change. When these same flowers were transferred from the sulphurous acid to a current of ozonized oxygen, the azalea turned red on the edges and colored somewhat throughout; the camellia reddened, so likewise the mimosa; the *Abutilon* became red along the veins, the petals of *Ixia* turned red at the edges, the nasturtiums reddened in places, the *Bouvardia* became brown, the *Strelitzia* did not change.

When similar flowers, which had been longer exposed to ozone without change, were placed in an atmosphere containing chlorine, the camellia became buff color, its leaf unaffected; the azalea turned yellow, then white, its leaves partly changing also; the *Ixia* and *Bouvardia* became perfectly white; *Salvia*, yellow-white, its leaves yellow. The red veins of the *Abutilon venosum* were not bleached, but its green calyx and part of the stem were. The leaf of the *Abutilon insigne* was bleached in spots; the leaf and stem of the nasturtium became entirely white. The blue portion of the *Strelitzia* was bleached, the yellow in part, the red leaf not affected. Corresponding changes took place in other specimens of these flowers which had not been previously exposed to ozone.

The action of ozone as a bleaching agent differs not only from that of sulphurous acid, as might be expected, but also from that of chlorine; and it is not improbable that its use has been proposed for bleaching in cases where its precise action has been unknown.

It is a striking fact in the economy of nature, that an agent like ozone, which operates as nature's purifier and disinfectant, and energetically destroys decomposing and putrescible organic substances, should have so little action upon the delicate coloring matter of flowers.

My thanks are due to my assistant, Dr. George A. Prochagka, for his co-operation in the experiments detailed above, and to the Rev. S. B. Dod for his aid in the study of flowers.

STEVENS INSTITUTE OF TECHNOLOGY, May, 1878.

LIMITS OF THE COMBUSTIBILITY OF GASES.—M. Schützenberger.—The author proposes the following law: All other circumstances being equal, to every pressure from 0 up to 1 atmosphere, there corresponds a limited length of a gaseous column beyond which the combustion provoked by a spark ceases to be propagated, while for smaller distances it is transmitted to the whole mass.

## THE DIFFUSION OF SALICYLATE OF SODA.

THE rapid diffusion through the system of salicylate of soda, which its action and rapid excretion suggest, has been confirmed experimentally by MM. Ch. Livon and J. Bernard. In their investigations they have confirmed the conclusions of previous observers regarding the action of salicylate on the conscious sensibility; the production of tetanic contractions and convulsive movements, and disturbances of respiration and of the cardiac pulsations, due to the alteration of the reflex action of the medulla and cord. Their observations were, however, especially directed to the diffusion of salicylate in the economy, and the means by which it is eliminated. For the detection of the salicylate they have employed the perchloride of iron, which remains the most delicate reagent known. In the first experiment six grammes of salicylate of soda were injected into the stomach of a dog. The œsophagus was tied; two hours afterwards the salicylate was found in the saliva. In the second experiment ten grammes were injected into the stomach, and an hour afterwards the salicylate was found in the bile. In the third experiment three grammes of salicylate were injected into the femoral vein, and an hour later it was found in the bile. In a fourth experiment seven grammes were injected into the stomach, and four hours later the salicylate was found in the pancreatic juice. In a fifth, two centigrammes were injected under the skin of a guinea pig, and one hour afterwards the salicylate was found in the milk. The method of detecting the substance was to heat the liquid with hydrochloric acid, and then shake it up with ether. Evaporation of the ether leaves a residue which gives, with perchloride of iron, the characteristic violet tint. The saliva, the bile, and the pancreatic juice were collected by means of fistulæ. The fæces and urine also showed evidences of the salicylate. In all the experiments upon dogs it was found also that the cerebro-spinal fluid contained salicylate, even several hours after the administration of the drug. It is suggested that probably it is the presence of the drug in the fluid which bathes the central organs of the nervous system which accounts for its action upon them. By the injection of from two to ten centigrammes of salicylate through the occipito-atloidean ligament into the spinal canal, all the phenomena of salicylate poisoning were rapidly obtained. The precaution was taken first to withdraw an equal bulk of the cerebro spinal liquid, so as to prevent any compression of the cord. For the sake of controlling the experiment, simple water was, in another experiment, injected in the same manner, with the effect, however, of causing only prostration, and not the tetanizing effect of the salicylate.—*Lancet.*

SINGULAR USE OF FLUORESCEIN.—To determine whether the head waters of the Danube found their way through subterranean passages into the Aach, a quantity of fluorescein was placed in the former river, and three days later the splendid green color with golden reflections was quite distinct. Ten kilos of fluorescein had sufficed to color, in an indisputable manner, 200 million liters of water.

## ON A NEW METAL—PHILIPPIUM.

By M. MARC DELAFONTAINE.

THE researches in which I have been engaged for more than two years on the Samarskite earths* have led to the discovery in that mineral of a fourth earth belonging to the yttria group. This mineral is yellow like terbia, but its equivalent is lower. My researches on the gadolinite metals had formerly led me to a similar conclusion, which, however, I was prevented from establishing on account of the destruction of my laboratory in the great fire of Chicago.

As this new earth occupies an intermediate position as to color and weight between yttria and terbia,† it might naturally be supposed that it is after all only a mixture of these two bodies. But the numerous and varied experiments that I have made convince me that such is not the case. Further, profiting by the examination which M. Soret has just made of the absorption-spectrum of erbium, and also by his recent study of the spectra of other earthy metals,‡ I have been enabled to confirm the correctness of my other conclusions.

I therefore announce definitely the discovery of the oxide of a new metal, to which I have given the name of Philippium (Pp), in honor of my benefactor, M. Philippe Plantamour, of Geneva, the friend and pupil of Berzelius. I may remark, in passing, that this name adapts itself perfectly to the ordinary terminations of chemistry, not only in the French, but in the English, German, and Swedish languages. Thus the earth will be called Philippine in France, Philippia in England, Philipirde in Germany, Philipjord in Sweden.

The following are its distinctive characteristics:—Admitting provisionally that philippia is a protoxide, its approximate equivalent is comprised between 90 and 95. I cannot be more precise at present. The metals of the cerite and gadolinite groups are like fatty bodies or alcohols of the ordinary series; they are recognized easily in the pure state, but they are separated with great difficulty, and this difficulty is increased when they are from five to seven in number.

We have yet no means of knowing if philippia is completely free from yttria, although it is easy to reduce to a great extent the proportion of the latter. Erbia and philippia are mutually carried down and held by each other with such tenacity that I have not yet been able to obtain a complete separation of them.

The philippic formiate crystallizes with great facility, either on cooling or by spontaneous evaporation, in small brilliant rhomboidal prisms less soluble than the formiate of yttria, which is deposited in mammillary form of a sirupy solution. The terbic formiate is anhydrous, and soluble in from 30 to 35 parts of water. The sodio-terbic sulphate dissolves with difficulty in a saturated solution of sodic sulphate, while the corresponding salt dissolves in it easily. I avail myself of this property to simplify the extraction of these bodies. The philippic oxalate is more soluble in nitric acid than the terbic salt, but less so than the yttric salt. The philippic nitrate becomes a deep yellow color when it is dissolved; those of yttria and terbia remain colorless. The salts of philippium are colorless; the earth becomes white in a current of hydrogen, and also on being calcined, but it becomes yellow again on exposure to the air during cooling. This color does not appear to be due to any mixture with terbia.

In the spectroscope the concentrated solution of philippium gives in the indigo blue ($\lambda$ = about 450) a magnificent absorption band, very intense, and rather broad, with well defined edges, especially on the right. This band, which strikes one at a first glance, is not seen in solutions of terbium, yttrium, and erbium. It is, then, characteristic of philippium, and thus M. Soret's conjecture that it belongs to a new simple body is confirmed. In the green I find two rather fine rays varying in intensity, the most refrangible of which belongs to erbium, as well as a faint ray in the blue near to the boundary of the green. The least refrangible of the green rays belongs perhaps to philippium, for if in some specimens it has been less intense, others, on the contrary, show it to be nearly as powerful as the erbium ray. Lastly, in the red there is at least one fine ray which I am not able to identify. By directing the slit of my spectroscope to the sun I observe through a dark glass with the terbium solutions a very pronounced band situated in the violet ($\lambda$ = 400 to 405). This, however, is difficult of observation. It is half the width of the philippium band, and seems to be entirely absent in certain specimens of the latter, while in others a trace of it is visible. I have reason to doubt whether this really characterizes terbium, as M. Soret believes; it is possible that it may indicate yet another element, the atomic weight of which is intermediate between that of terbium and erbium.

I have for some time been pursuing the parallel study of the compounds of philippium and terbium, and in a few weeks I shall be able to publish a memoir in which I shall describe at length the methods of preparation and purification which I have employed.—*Comptes Rendus.*

* *Archives des Sciences Phys. et Nat. de Geneve*, March, 1878, p. 273.

† YO 74·5, TbO = 114.

‡ *Archives des Sciences Phys. et Nat.* August 1, 1878, p. 89.

## BETTER PHARMACEUTICAL EDUCATION.*

By RICHARD V. MATTISON, Ph.G.

THAT "there is no training like the training of the shop," practically, we admit, but we hail with ever-increasing pleasure the advent of the usual winter courses of lectures in the various colleges where pharmacy and the allied sciences are taught. Here the training of the shop is supplemented with the theories and facts, the thorough knowledge of which all combine to make the successful pharmacist. The day is at hand when pharmacy ranks as a profession, and we trust the day is never to return when the pharmacies of an enlightened civilization are to be left at the mercy of any others than professionally educated pharmacists.

Steadily, year by year, the increasing number of students gives promise of a wider field of usefulness, is evidence that the hearts of many are beating in unison upon the question of the better education of the pharmacist; each one of us, individually, can do little, but collectively we can do much good, and in this connection we should each resolve that some portion of our time, at least, shall be given to the cause of better pharmaceutical education.

To the young man just entering the favored domain of science, we can lend a helping hand, and assure him that up the ladder there is plenty of room. To the student we can say, learn everything thoroughly, know every preparation of the Pharmacopœia thoroughly, do not learn, simply, that to make a successful tincture of aconite, requires percolation of a powdered aconite root, in fine powder; make a thorough analysis, through the aid of reason, of every preparation; ask yourselves why, *e. g.*, aconite root must be in *fine* powder? Why do we use stronger alcohol as a menstruum? keep the dose, and when an article or preparation is poisonous, the antidote, in your mind, ready at a moment's warning, should use require it.

Remember *why* potassic sulphate is used in Dover's powder; *why* the water of ammonia is used in the purification of ammonic chloride, or the zinc carbonate in the purification of zinc chloride; *why* sugar is used in the preparation of Vallett's mass, and *why* the water is directed to be previously boiled that is used in washing the precipitate.

Remember why acetic acid is used in the formula for fluid extract of ergot, or why the Pharmacopœia directs the moistened powder of wild cherry bark to remain a number of hours before percolation, and why glycerine and water is used as a menstruum in the first portion of the process.

Why should large doses of mercurous iodide, when prescribed with potassic iodide, command your undivided attention, or prescriptions containing poisonous alkaloids or alkaloidal salts be a dread when associated with the aromatic waters?

Why ammonic chloride is added in the analysis when magnesium is sought, or why the potassic solution is to be first acidified with hydrochloric acid, are things to be not simply remembered, they are things *to be understood*. Almost every process of the Pharmacopœia is a text for study, a text for thought, and the analysis of reason.

It is not simply the remembrance of these things which go to make the pharmacist, it is the understanding of them; the thorough appreciation of the *reasons why*, that makes the man the master of his profession. It is the understanding, embracing the structure of drugs, which leads the pharmacist into the field of original research, which leads to the

* Read at the social meeting of the Alumni Association, of the Philadelphia College of Pharmacy, October 3d, 1878. (*Phil. Druggist and Chemist.*)

perfecting of imperfect formulæ, the purification, the preservation, or the preparation of remedies.

This is the meaning of a better pharmaceutical education, a thorough knowledge of all the facts in connection with the science of practical pharmacy. What our country needs now is, not *more* pharmacists, but *better* ones; it is not *more* colleges of pharmacy, but *better* ones. Our need is graded courses of instruction, longer terms of study or closer application, the former preferably; the personal interest of preceptors, and the direct personal interest of students in their life work. The student must be taught to forget that he comes to the college of pharmacy to earn its diploma. He has a brighter future than earning a degree, however honorable may be the standing of the college conferring it. He comes to the college of pharmacy, of this and of our sister cities, for the purpose of laying the groundwork of his future life, for the purpose of acquiring a knowledge of how to study, for the purpose of ever after being a better, brighter, more active member of the great brotherhood of scientists. This is what we mean by better pharmaceutical education. It is the appreciation of this which makes the future of pharmacy the silver lining in the dark cloud of the past, and from its edges glance the warm rays of the bright sun of better pharmaceutical education.

## AN EL DORADO FOR APOTHECARIES.

THE following we quote from a local paper of Carlsruhe, capital of Baden, Germany:

"The Board of Charities has entered into the following contract with the apothecaries of this city:

"The apothecaries shall quarterly prepare lists of those of their debtors for medicines, etc., whom they believe unable or unwilling to pay. The Board shall select from those lists those cases in which public charity is called for, or in which the city might for some reason be held responsible, the bills incurred in such cases being subsequently paid by the city. The cases rejected shall be legally proceeded with by the respective apothecaries within three months after the lists have been returned to them. The judgments received shall be brought to execution immediately. Should any of the judgments remain unsatisfied, the city pays the respective amounts and costs of court." It must be added that in Germany no apothecary has a right to refuse dispensing medicines and other articles, when ordered by a regular physician, no matter whether they feel inclined to trust the customer or not. Medicine must be furnished under all circumstances; hence the responsibility of the Charity Board.

## PROF. HUXLEY ON THE HAND.

FOR his recent inaugural lecture as President of the South London Working Men's College, Prof. Huxley took as a subject "The Hand, and what is to be learned from it." He said that this portion of the human frame was, perhaps, the most important next to the brain itself. He did not know that he should except even the brain, because if man had not the hand, whereby so many messages were conveyed to the brain, the latter organ would be comparatively worthless. The hand was capable of an endless diversity of operations, while it was the most delicate organ of touch that man possessed. By its aid we learned the hardness, temperature, and weight of bodies; it was the instrument by which the great majority of manual labor and all sorts of handicrafts were performed. Besides, it was one of the most powerful instruments of communication, by signs, between man and man, and travelers who have been to the West of America, particularly among the trappers of that region, testify to this fact. Prof. Huxley next went minutely into the anatomy of the hand, explaining lucidly the various tendons, muscles, and joints. The various motions of the fingers, wrist, and arm he showed by diagram, as also the position of the thumb to the other fingers. The muscles supplied the steam, so to say, to the human machine. These were made up of long fibers, having this peculiarity—that when an impression was sent by the will to them they changed their form and became shortened, and at the same time thickened to a corresponding extent. Every movement of the hand depended upon this contraction of a single muscle, or a combination of muscles. The hand and fingers of a man playing a fiddle went through a most astonishing operation. A good player had to guide the movement of the hand to the fraction of an inch, or he did not give the string the tension necessary to produce a certain note. He had at the same time to regulate the bow, and yet all this he did with the greatest accuracy and nicety, though the operator himself, if he were not an anatomist, knew nothing about it. Many of his hearers, said the professor, might have read "Paley's Natural Theology," though it was now almost forgotten. Paley, speaking of design, used the argument that if a man found a watch on a heath, and observed the number of contrivances to mark time, could he fail to conclude that the watch had been made by some one, and put together with the intention of doing that which it did perform? Paley scouted at the supposition that any one would come to any other conclusion. He then drew a like conclusion from the human fabric, which was formed to execute certain functions, which it faithfully performed. There might be considerable difficulty raised as to the safety of applying the argument from analogy to a new case in all its strictness and force, as Paley did, but it was not necessary to do that. Professor Huxley, having traced the various stages of man's development, observed that the frame of a man did not bear a precise analogy to human means of construction. Man had not the materials in the one case as he had when he made a watch or a steam engine; and the difference was as great as the difference between making a steam engine out of iron, and taking a bit of iron and letting it grow into a steam engine. It was important to know that so complicated a structure should be developed through natural operations. Topsy, in "Uncle Tom's Cabin," when asked who made her, replied that she did not know; and had she, instead of being an African negress, been instructed as her white neighbors, she could not have given a more correct answer, or one more in accordance with the fact. In the same way as the hand had grown, so, on a larger scale, had the whole fabric of the human body grown in the sense that Topsy said she had. There was a time when the human body was only the 120th of an inch in diameter. As the hand had been evolved, so had the whole of the human body; and every one was a living example of the fact that the most complicated machine in nature took its process on that which he called evolution. It was a thousand pities that those who had to do with children and young people took the course that Topsy's excellent friends did with her. There were two courses to be taken with the young—first, if you know what you are talking about, say what you know, though the subject may not be suited to them; if you do not know, say so. This will have the effect of dealing fairly with your own conscience, and respectfully with the conscience of the child, together with preventing your being put in that disagreeable position of being considered a cyclopædia of information that can never be in the wrong. A child, continued Prof. Huxley, could understand one theory as well as another, just as he understood how a seed placed in the ground grew up into a plant. Besides, this theory of evolution had the advantage of being true, while the other statement conveyed an erroneous idea, which had, some time or other, to be shaken off. If these ideas, which were so simple in themselves, and beyond doubt, were put into people's minds as a part of their instruction, could any one imagine there would be that preposterous outcry against the application of the theory to the animal and vegetable world? If they were to make use of any argument, depend upon it that for the purpose of natural theology the fact of evolution afforded a vastly more noble and enduring ground on which to build that argument than any other.

## PAINT FROM A SANITARY POINT OF VIEW.

IN a paper entitled "The Chemistry of Dirt," read before the Sanitary Institute of Great Britain during its recent congress at Stafford, Dr. H. C. Bartlett, the author, after strongly recommending the abolition of absorbent surfaces on the walls of our dwellings, goes on to say:

"If we have lath and plaster let it be painted, and if we cannot have wainscot or mahogany kept brilliant by continued cleanly friction and polish, let us have a clean painted wooden surface, as artistic in tint and in the disposal of the colors and decoration as taste and means will permit, but to carry out a determined war against dirt and disease, let us have paint. These are no longer notions peculiar to the Dutch. They are sanitary axioms which we cannot afford to ignore.

"But there is another side to the proposal to 'paint and believe in paint,' as I observed in the commencement of this paper; sometimes the very means taken to keep our dwellings clean adds to the real dirt. So it is with paint, for there be paint and paints; some leave little to be desired from a hygienic point of view; others, as I shall show, are injurious to health and even deadly in their direct effects.

"In July, 1873, I was instructed to investigate the causes which brought about, I believe, some of the severest cases of lead poisoning ever made public. I found at Devonport Dockyard twenty-four cases had occurred among the shipwrights working there, dating between May 3 and June 30. There were 64 painters employed, and on the average about four cases of lead poisoning per annum were reported of these men, or at the rate of 8 per cent. of those engaged in laying on the white lead paint. When the space to be painted was confined and ill-ventilated, the symptoms were such as Dr. Thomas Brown, R.N., described in his report, which by permission of the Director-General of the Medical Department of the Navy, I am able to quote: 'After a few weeks' work, a pasty, lusterless look appeared upon their faces. There was a sense of great depression and weakness, together with headache and loss of appetite. A metallic taste was sometimes complained of, and a blue line was observed upon the margin of the gums. It was only after persevering for a few weeks that the graver symptoms were produced, and the men becoming wholly incapacitated sought medical advice.

"'But it was among the shipwrights that the symptoms appeared in a still more aggravated form. These men were employed in cleaning off Day's cement together with the paint and red lead. All the symptoms previously enumerated were presented, but in a more intense degree, attended with greater depression, and in every case epigastric pain was described as a dull heavy pain giving the sensation of the bowels being drawn towards the spine. Cramps in the muscles of the extremities were common and of great severity, but it was observed with surprise that there were no cases of paralysis. The most stringent precautions have since been taken; perfect cleanliness of the skin and frequent washing of the working clothes were insisted upon. A chemical respirator was recommended to be worn while at work, and sulphuric acid drinks were always to be kept in readiness. No precautions, however, prevent the use of white or red lead paints being exceedingly injurious, both to the painters and to those who inhabit rooms in which the paint has not properly dried.'

"Now comes the important question, how long a time must elapse before white lead paints can be considered to be so perfectly dried as to be absolutely free from diffusing their injurious influence? I will reply that it depends upon circumstances over which we have frequently no control. I state this feelingly, as in my house, a few doors from Grosvenor-square, London, the whole staircase from top to bottom has paint upon it which is not dry now, although it was laid on at Easter last, while I was at Brighton.

"The slightest greasy deposit upon the old paint will prevent white lead paints from ever really drying, and while a skin of apparently hard paint cheats the superficial observer, there is a continual exosmosis of volatile poisons being given off. The truth is not revealed until a general tone of depression and lowered vitality throughout the house arrests the attention of observers on the lookout for such causes and effects. Or, perchance, the spirit of cleanliness, that handmaiden to the goddess Hygeia, insists upon an early cleansing of the paint all over the house, with the unpleasant result of detaching the false skin of the new paint and leaving the greasy under-coat which no length of exposure will ever dry. It is no exaggeration to assert that very little paint, containing white lead as its basis, becomes so hard and dry within months of its application, as to preclude the possibility of poisonous matters being given off.

"I have had distinct proof that the injury accruing from the diffusion of lead in the air exists to an extent far surpassing the well-known poisonous influence of minute quantities of lead in drinking water. I have, therefore, always recommended the substitution of zinc white for white lead, for the all-important reason that it is harmless. Many reasons, however, tend to limit the use of the ordinary zinc white (oxide of zinc), the weightiest of which are that it does not possess the body of white lead, will not cover so much surface, and is therefore not so economical either in labor or in cost. Several coats of zinc oxide are required to equal the opacity of white lead, and in mixing with other colors a much larger quantity of zinc oxide must be used.

"I have lately had brought before me a new preparation of zinc which is stated to have overcome all these defects. As I have carefully investigated its properties, I am happy to find that we have at length obtained an antiseptic white zinc paint, which is free from the objections raised against zinc oxide. I find the oxy-sulphide of zinc pigment, invented by Mr. Thomas Griffiths, of the Liverpool Silicate Paint Company, to be a very curious instance of the fulfillment of the demands of sanitary science. We insisted that we must have a non-poisonous white as the basis of the oil paints used in our dwellings. Zinc oxide was proposed, and, I believe, large fortunes have been made out of its manufacture, notwithstanding the drawbacks. The economies of labor and expenditure must, however, be included within the demands of sanitation, or the use of the best and most harmless pigments is certain to be evaded. The flat of the trade is issued against it, and it becomes doubly dear and difficult to insure its use. Oxy-sulphide of zinc is then brought forward, as dense as white lead, and as opaque, its covering qualities even exceeding those of the lead paint; and, as it does not change color like white lead, is as cheap, all things considered. We may welcome another powerful auxiliary, which, while innocent of itself, will help us immensely in our campaign against dirt and disease."

## THE PURIFICATION OF SEWAGE.

### PROGRESS IN PURIFYING SEWAGE BY PRECIPITATION.*

By HENRY ROBINSON, M.I.C.E., F.G.S.

THE object of this communication is to lay before the congress certain practical and economic results which the writer has arrived at in regard to perfecting the purification of sewage by chemical treatment, and in facilitating the disposal of the sludge derived therefrom. He desires to acknowledge the valuable co-operation he has received from Professor Wanklyn and Mr. J. C. Mellis, C.E.

Since the writer's book on the "Purification of Water-carried Sewage" was published in 1877, he has continued to follow the lines laid down therein as requiring, from his experience, to be adhered to in treating sewage chemically, and his more recent experiments and practice fully bear out their correctness. They may be briefly stated to be as follows:

To employ chemicals, which, besides being precipitants, are also disinfectants and deodorants, which are readily obtainable in large quantities and at low prices, and which can be used in solution so as to avoid adding solid matter to the sludge. The fulfillment of these several conditions is what has now been accomplished to a greater extent than hitherto.

In considering every system for dealing with sewage it is desirable that the question should be regarded as a means of enabling sanitary authorities to overcome the great and increasing difficulty in the disposal of their sewage refuse at the least cost, rather than as one for making money out of sewage, which has been too much aimed at, and has thereby thrown back sanitary improvement considerably.

In the course of the writer's experience in advising with reference to precipitation works and systems, he has seen more and more clearly that sulphate of alumina aided by milk of lime proves the most efficient agent to comply with the before-mentioned conditions for purifying sewage. This he has now advanced upon, inasmuch as he has discovered that the efficiency of sulphate of alumina is greatly increased by the presence of some proto-sulphate of iron which apparently produces results altogether out of proportion to its chemical equivalent (the salts of iron being known to chemists as purifiers of foul fluids), the proportion varying with the composition of the sewage, but their combination having a marked sanitary and economic advantage.

Practical data on a large scale have already been obtained at the sewage precipitation works of the Rivers Purification Association at Coventry and Hertford (to whom the writer is engineer), where the improved system of working has been adopted with complete financial and sanitary success. The process previously employed at these places, was (as is well known with reference to Coventry), crude sulphate of alumina and milk of lime, which gave results admittedly of a highly satisfactory kind. The addition of the salts of iron has, however, led to the production of an excellent effluent and at a cost less even than previously.

The employment of this combination has also resulted in the tanks and the sludge being deprived of the slight smell hitherto noticeable at times. The economic results attending this compound system of precipitation will be recognized when the writer states that at Coventry Sewage Works the purification of the very foul sewage (containing between six and seven grains of chlorine per gallon and between twelve and thirteen parts per million of albuminoid ammonia, with a large amount of dye from the manufactories) is now accomplished for £1 1s. 6d. per million gallons.

This sewage is equivalent to fifty gallons per head of the population per diem, the minimum flow being two and a quarter million gallons a day. The necessity for the adoption of such a standard of flow cannot be too strongly insisted on, as the most fallacious estimates about sewage treatment by every system have been arrived at through ignorance or neglect of this essential consideration.

The writer has frequently met with cases where the cost of purifying the drainage from only a partially water-closeted town, largely diluted with subsoil water, until its flow is equivalent to a hundred gallons per head per diem and upwards, has been compared with the cost of purifying a concentrated foul sewage of less than fifty gallons per head per diem. At Hertford the improved system of working has been applied with equally satisfactory results.

The way to dispose of the sludge from precipitation works has long engaged the attention of the writer. Artificial heat will accomplish it, and several ingenious appliances have been devised for this purpose. The cost, however, is heavy, and the value of the resulting manure is not yet sufficiently established to justify its employment on commercial grounds.

The writer has now adapted the system of removing the water from the sludge by means of filter presses, and he has devised a simple appliance to economically effect this, a model of which is in the museum of this congress.

This press, which is founded on an old and well-known Belgian apparatus for filtering impure liquids by means of a combination of disks with filtering cloths on their surface, has been arranged in order to economize labor and time in working, so that the disks open and shut automatically, by which the pressed sludge is removable quickly and without disturbing the filtering cloths. The fluid sludge is thus converted rapidly and economically into the form of cakes, and the drying can be further carried on to any desired length either by exposure to the air or otherwise. The difficulty hitherto experienced in disposing of the sludge to farmers for utilization upon land is thus got over, as the writer has found that there is no difficulty in selling the sludge from the process he is referring to, provided it is made portable. The theoretical value assigned to sludge from the writer's process is, according to eminent chemists, 16s. 9d. a ton if it contains about 50 per cent. of moisture, or 27s. a ton if dried down to 15 per cent. of moisture. Although in time the value of this sort of manure will be more fully recognized than it has been, at present it is wisest to

* Paper read before the Sanitary Institute of Great Britain, at Stafford.

confine the drying to the conversion of the sludge into a portable form and so get rid of it, at the moderate price it readily commands. When farmers have agreed to pay the real value assigned to it by chemists, further drying, fortification, or other manipulation, can be resorted to.

The writer prefers to limit the operations at sewage works which he has to advise on to the purification of the sewage, and to getting rid of the product at the least cost. In time, he quite thinks the sludge manure will return a considerable part of the annual cost of working.

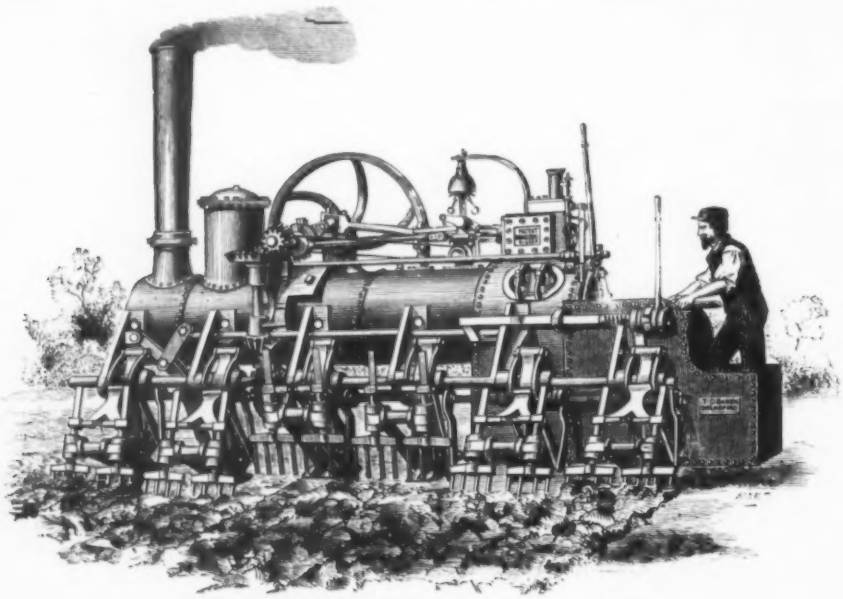
The improved method of purifying sewage and of disposing of the sludge herein recorded may be regarded as an important advance in regard to sewage treatment. To the sanitary authorities of the numerous towns where land cannot be obtained, either of sufficient area or at a reasonable cost, for the purification of the sewage, or to the authorities of seaside towns where pollution of the foreshore results from discharging raw sewage into the sea, the information contained in this communication will be useful, and can be relied on, as the outcome of practical experience.

## DARBY'S STEAM DIGGER.

THE engraving represents the machine at work. It travels over the land broadside on, taking a breadth of sixteen feet each time. The digging apparatus is attached to one side of the machine, and consists of six pairs of forks attached, and working in combination with six legs. On the other side there are two pairs of wheels; these, together with the legs, take the weight of the machine evenly and equally.

In traveling from place to place the two pairs of wheels are removed from the side and placed at each end of the machine, propelling it in the ordinary way.

A horizontal shaft extends alongside the engine and tender, upon which are six eccentrics, working alternately the several legs and forks, producing a smooth onward movement at the rate of two to four furlongs per hour. In turning the machine one of the outside legs mark time, and the others step round like soldiers wheeling. The whole gearing consists only of two pairs of bevel wheels and a short downright shaft from the engine crank shaft. Thus nearly all the power is applied direct in moving the land. The thickness as well as the depth of the spit can be easily adjusted.



THE BROADSIDE STEAM DIGGER.

The engine is eight horse power, and is capable of digging eight acres per day, ten inches deep—only one man required to work the whole.

The advantages of this system of cultivation are obvious. A great saving of power and manual labor is effected, and ropes, riggers, windlasses, anchors, and porters dispensed with. Thus wear and tear is reduced to a minimum.

Aeration, the principal object of all cultivation, is effected in a greater degree by spade husbandry than by any other mode; in fact, more good is done in one operation than by several repetitions of the usual processes. The subsoil is left in a rough and broken state without being brought to the surface, allowing the atmosphere to act upon it as well as on the upper part of the staple, which is more thoroughly prepared for the reception of seed than by any other mechanical operation however expensive. The rain and roots of plants penetrate the subsoil without being intercepted by the tread of horses or the sole of the plows. The American agent is T. F. Francis, London, Ontario, Canada.

## SHALL I PLOW THE LAWN?

MR. EDITOR:—My lawn (¾ acre) has been much eaten by the larvæ of June beetles, and the grass destroyed has been replaced by witchgrass and rank weeds. I write you to ask if I will do well to have it turned up and left in a rough state during the winter? Then, in the spring, plow and harrow, apply manure, and sow down to grass. What variety of grass seed should I sow? Your answer, through the *New England Farmer*, will much oblige F. A. L.

MILTON, Mass., Oct. 5, 1878.

REMARKS.—The insects which have destroyed your grass are undoubtedly the larvæ of the May bug or dorbeetle, an insect which is supposed to live, in all its stages, about three years. The first summer they are so small as to attract little notice, but during the second year they become very voracious, and complete their growth, when they are commonly known among farmers as the red-headed white grub. They eat the roots of grass about an inch below the surface, often making such thorough work that the turf of a whole field may be rolled up into mats like the rolls turfers use for sodding lawns.

In a wet season the grasses throw out new roots so readily that the sod may not be destroyed, but in dry seasons, when growth is slow, these insects become exceedingly destructive, destroying all the finest grasses, and leaving only coarse, rank weeds to take their places.

We know of no method of preventing the ravages of the dorbeetle, and when they get into a lawn it may as well be counted destroyed, for the season, at least. The grubs have done eating now, and are working down into the soil below shallow freezing, where they will, before next June, be transformed into the perfect insect, and in warm evenings will make our acquaintance by thumping their noses against our lighted windows. In a still evening they may be heard in our cherry trees, humming like a swarm of bees, as they fly among the leaves, which they eat greedily.

If you plow and reseed the lawn, it will be liable to be injured again within two years from the time the seed is sown; so, were it not for the witchgrass, we should be inclined to recommend sowing and harrowing in seed next spring, applying a liberal dressing of some kind of manure at the same time. It is quite expensive making a good lawn, and, when once made, the turf should be preserved, if possible, without plowing.

Again, if there is much witchgrass, you will not be likely to exterminate it in one winter. A whole season will be required, unless the roots are dug out perfectly clean and carried off the field. So the answer to your question would be indicated by the *amount* of witchgrass in the soil. You can destroy a few square feet of it by hand labor, but if the whole three-fourths acre is infested, we would recommend making thorough work of it by plowing and cultivating through the season. If not very plenty, it would be better to destroy the little by hand digging and then scarify the surface with a fine-toothed harrow, like the Thomas smoothing harrow, sowing plenty of seed and manure at the same time. The earlier the work is done in spring, after the ground is fit to work, the better. By working the land often and thoroughly, you may be able to get it ready for reseeding by the first of next August, the best time in the whole year.

There is no better mixture of grass seed for a lawn than Kentucky blue grass and Rhode Island Bent, in equal quantity by weight, say fifteen to twenty pounds of each per acre.—*New England Farmer.*

CALIFORNIAN sumac is said to contain 20 per cent. of tannin, while the Virginian contains 24.

[Continued from SUPPLEMENT No. 153, page 2442.]

## RISE AND PROGRESS OF BEE CULTURE.

THE first record of a movable frame hive in America may be found in the *Cultivator* for June, 1840, by Solon Robinson, now of Jacksonville, Florida. The second invention may be found in the SCIENTIFIC AMERICAN for March 6th, 1847. The inventor, Mr. Shaw, of Hinckly, Ohio, I believe is still living. Movable frames were also used by Marcus Robinson at Jamaica Plains, Massachusetts, in 1848, and varied in no respect from the Langstroth frame and hive. This on the affidavit of Solon Robinson. The same style of frame was used about the same time at Danvers, Massachusetts, as per the affidavit of Mr. Putnam, of Galesburg, Illinois. These affidavits are on record in the office of the Hon. A. F. Perry, corner of Main and Third streets, Cincinnati, Ohio.

Harbison, Townley, Flanders, Metcalf, and some others claim to have known of movable frame hives between 1845 and 1850. A few books were written on bees about this time, but possessed little merit either in theory or practice.

About 1852 the Rev. L. L. Langstroth patented the hive which still bears his name, and which many prominent bee keepers still use with but slight modifications. This gentleman took hold of the matter in earnest. He sold large portions of the territory covered by his patent to influential and wealthy men, who, in connection with himself, introduced the hive far and wide, and thus demonstrated that a patent is not necessarily an evil, as many seem to suppose, for it proved in his hands a powerful means of advancing the true science of bee culture. This he soon followed up with his book, "The Hive and the Honey Bee," which is perhaps the most complete and scholarly production of its kind ever written in any age or country, and shows its author to have been perfectly familiar with the best literature on this subject in the Old World, and a perfect master of both the science and practice of bee keeping. To Mr. Langstroth, although not the first, more than to any other man, are we indebted for the introduction of new races of bees to mix with our own, and thus prevent the evil of in and in breeding.

The "Mysteries of Bee Keeping Explained" appeared simultaneously with Mr. L.'s book. The author, the late lamented M. Quinby, showed in this work a familiarity with the economy of the bee truly astonishing in one writing at that time. It was eminently practical, and did much valuable work for the advancement of rational bee culture. He also invented the best form of bellows smoker then in use, and this has been further improved by the addition of the direct draught principle invented by Mr. T. F. Bingham, which leaves nothing more to be desired in this line.

Mr. Quinby wrote largely for the agricultural press of the country. He freely gave all his ideas and inventions to the public for the promotion of the cause he loved, and labored faithfully to raise bee keeping to the dignity of a distinct profession. The quiet, noble, self-sacrificing spirit manifested by this *truly* great man will be talked of and cherished and felt as long as the keeping of bees shall engage the attention of men. The writings of Mrs. Tupper, the Harbisons, Metcalf, N. H. and H. A. King, Prof. Cook, and others have done a vast work in bringing about the present advanced stage of bee keeping in this country, while A. I. Root, T. G. Newman, and your humble servant, realizing that "constant dropping wears out a stone," are constantly pelting away at the superstitions and prejudices of the people, and hope ere long to end the battle in complete triumph.

The most convincing arguments, however, are those which appeal to the *palate* and the *pocket*, and these are being effectually used by Harbison, Hetherington, Doolittle, Betsinger, Clark, C. J. Quinby, and many others, in the shape of tons of honey as beautiful and pure as the "nectar which Jupiter sips," and this is being distributed all over the world by Thurber, Quinby, E. & O. Ward, Thorn & Co., of this city, Muth, of Cincinnati, Vincent, of New Orleans, and by the large dealers in other cities. We learn from statistics that there are now in the United States about 1,000 different bee hives covered by patent, and a still larger number unpatented. Nearly all the inventions of European origin have been greatly improved by our Yankee ingenuity, and men everywhere are waking up to the importance of this industry as never before. The aggregate yield of honey is largely on the increase; besides the quality and quantity and the methods used in America are far superior to any other country, and these facts, taken together, are creating a fear in the minds of some of our most thoughtful apiarians that the prices received for honey may fall below the cost of production, so we will present a few facts which we think may tend to allay these apprehensions:

Great Britain consumes annually about 9,000,000 lbs. of sugar for brewing purposes; other foreign countries, as well as our own country, a proportionally large amount. It is a fact that extracted honey contains a much larger percentage of the elements needed as a substitute for malt than sugar does, and is cheaper at 90 cents a gallon than sugar is at the lowest price it has yet reached. A desirable change by substitution is now going on, and may be greatly hastened by well directed efforts on the part of honey dealers.

2d. Not more than two-fifths of our people have yet learned to eat honey, not because it is not generally acceptable, but it has never been brought to their notice as a staple article which may be had at the same price as the best quality of sirup, and that it is far more healthful.

3d. A large percentage of the sirups in general use in our families are badly adulterated and positively unfit for the human stomach, and particularly the stomachs of children. This fact is fast being recognized by the most intelligent of our population, and only needs a little judicious pressing through the papers to displace it, and in its room put extracted honey.

4th. Laws against the adulteration of honey, affixing such penalties of fine and imprisonment as shall afford complete protection to the producer, the honey dealer, and the consumer. Steps should be at once taken to effect this desirable result before some other unprincipled honey dealer shall cause Great Britain to give us the second slap in the face through their leading papers, by branding us as a set of swindlers, and warning the English people against the use of American honey.

A petition setting forth this matter in its true light should be presented to Congress at its next session. All the members of this National Convention, including all dealers in honey, should be asked to sign this petition, and a refusal from any cause whatever should be regarded as favorable to honey adulteration, and producers should be warned against selling such persons their honey.

Such a petition, praying for so laudable an object, and backed by so many honorable names, could hardly fail in obtaining the desired law, when extracted honey would at once advance to its true position in all our markets. Bee keepers everywhere should be united in bringing about these needed reforms, and, imitating the politicians, should "keep it before the people" till the end is attained. The journals devoted to bee keeping should be bold and outspoken on this subject, regardless of all present emoluments for a contrary course, and for one I here and now pledge the *Bee Keeper's Magazine* to this policy without the least equivocation or mental reservation, and I expect to see friend Newman, of the *A. B. J.*, join hands, and then, by a rising vote, test the sense of this Association, and thus make a significant stride in the true progress of bee keeping in this country.

A vote of thanks was given Mr. King for his valuable address, and moved that it be printed in full.

## NEW PLANETS.

FOUR more minor planets have been discovered lately within a few weeks. No. 189 on September 18, by Prof. Peters, at the Observatory of Hamilton College, Clinton, New York; No. 190 by Prof. Watson, at Ann Arbor, Michigan; No. 191 on September 30, and No. 192 on October 2, both again by Peters, who for some years past has been the most successful planet-hunter, his last discovery raising the number of his unanticipated discoveries to thirty-two. This last planet is announced to be of the ninth magnitude, and is on that account noteworthy, since such a bright planet has not been among the newly-found ones for some years. The planet No. 188, discovered by Peters on June 26, has received the name of Menippe.

LUMPS of salt, in the form of hailstones, are said to have fallen at Mantua, on July 25th, during a storm. Some of them are in the possession of Professor Agostini, the director of the observatory.

THE production of bromine in the United States is at present about 1,000 lbs. daily, and could be easily quadrupled if the demand existed. The quantity exported to Europe during the year 1877 was 50,000 lbs.